

CHAPTER 4

HISTORIC AND EXISTING CONDITIONS

Chapter 4 contains analyses and descriptions of social, biological, and physical conditions as they existed historically, and compares historic conditions to current conditions.

Social conditions include land settlement and occupation, land uses, transportation and access systems in the assessment area, and a social assessment of stakeholders. Social changes occurred as Euro-American settlers moved into the subbasins, which were occupied by Native Americans. Land use changed from hunting and gathering to agriculture, mining, and logging, and most recently to a more dispersed economy that includes recreation and tourist businesses, among others. Road systems grew from trails and early wagon roads to administrative roads and roads connected with timber harvest, some of which are now being decommissioned. Trails have changed from traditional or functional uses to recreational uses, and a large portion of the assessment area has been designated as wilderness.

The assessment of historic and existing biological conditions and processes includes climate, air quality, geology and soils, hydrology and watersheds, aquatic habitat and species, landscape ecology, and terrestrial wildlife habitat and species. Fire suppression, as compared to historic fire regimes, appears to have had the most far-reaching effect of any factor on most of the biological elements of the assessment area. This is because the historic fire cycles, now disrupted, regulated pulse disturbances in the watersheds, not only affecting stream channels and water quality, but also changing plant communities and aquatic and terrestrial species habitat. Timber harvest and road building have affected terrestrial and aquatic conditions in some watersheds, causing shifts to press disturbance regimes. Portions of the area continue to function as strongholds for aquatic species.

LAND SETTLEMENT AND OCCUPATION

The Selway and Middle Fork Clearwater subbasins have seen numerous changes in land use patterns through the course of human involvement over the past 8,000 to 10,000 years. The region has experienced several waves of occupation over time, by groups of people including Native Americans, fur trappers and other mountain men, homesteaders, and early day Forest Service employees. These people interacted with the environment in various ways, extracting resources and manipulating it to their benefit.

PREHISTORIC OCCUPATION

Prehistorically, Native American groups, consisting mostly of ancestral Nez Perce (also known as Nimiipuu), but also including the Salish, and perhaps the Shoshone and Bannock) occupied this area throughout their seasonal movements. The first trails were created by these groups along the rivers and streams to areas including hunting and gathering areas in upland settings, adjacent areas such as the mountains and valleys of western Montana and east central Idaho, and the Salmon and Columbia River country. The first people to occupy this area may have arrived 8,000 to 10,000 or more years ago. The homes of the first known inhabitants of the Selway and Middle Fork Clearwater subbasins were temporary. Ancestors of the Nimiipuu inhabited the subbasins, and although they established seasonal and permanent villages, the people moved about the vast area to locations where more abundant food sources could be found according to the

EARLY EURO-AMERICAN OCCUPATION

seasons. The Nez Perce Tribe continues to have interests in various portions of the assessment area.

The types of prehistoric Native American sites that can be found within the Selway and Middle Fork Clearwater subbasins include camp sites, possible village sites, hunting, fishing, and other food gathering sites, travel routes, and locations that may have religious or spiritual significance. These previously occupied areas are located throughout the Selway and Middle Fork Clearwater subbasins, from the highest elevations to the lowest river valleys. Artifacts associated with the activities which took place at all of these types of sites can also be found in the region.

Very few of these sites have been excavated to date. However, sample excavations have occurred at a few sites along the Selway River in recent years, and they have produced materials that have yielded radiocarbon dates relating to the time of occupation of particular locations. From a site in the Moose Creek vicinity, two radiometric dates have been obtained. This site appears to have been occupied on at least two different occasions, around 2,580 and 1,150 years ago (Sappington and Turnipseed, 1997, p. 187). From another site located further up the Selway River, one prehistoric occupation is dated to about 3,060 years ago (Sappington and Turnipseed, 1997, p.190). From one site on the Selway River just upstream from its confluence with the Lochsa River, dates of about 1,070 (Armstrong, 1999) and about 700 years ago (Beta Analytic, 1999) were obtained.

Several sites along the Lochsa River, which is adjacent to the Selway and Middle Fork Clearwater assessment area to the north, have also been excavated, and radiocarbon dates have been obtained from them as well. One site was initially occupied between 10,000 and 8,000 years ago, and the densest occupation occurred between 6,700 and 4,500 years ago. Still later, the site was occupied up until about 2,500 years ago. At another site just upstream from the confluence of the Lochsa and Selway Rivers, occupation dates range from about 2,800 to 150 years ago (Sappington and Carley, 1989, p. ii). There are also sites that have been used by Native Americans up to the present time. From these few examples, it is clear that the Selway and Middle Fork Clearwater subbasins have been occupied repeatedly over the last 10,000 years. The Selway and Middle Fork Clearwater subbasins were also major thoroughfares for traveling, as evidenced by the overall number and types of sites and artifacts found in the area.

EARLY EURO-AMERICAN OCCUPATION

The first Euro-Americans to establish a presence in this region were fur trappers, who were followed by missionaries, in the early to mid-1800s. Fur trapping continued into the 1900s, although on a smaller scale than in previous years. In the 1860s, gold was discovered in several areas of what are now the Clearwater and Nez Perce National Forests. Thousands of eager miners came through the region. There were attempts to extract gold within the Selway and Middle Fork Clearwater subbasin assessment area, but those efforts produced little in the way of economic gain for the individual miners.

With this influx of people to the region, new trails and wagon roads were created, while existing routes were improved to accommodate the wagons and pack strings now regularly using these routes (USDA, Meadow Face EAWS, Draft, 1999, p. 78).

As the regional gold rush subsided, the next wave of settlers came. When they first arrived, all of the lands were in public domain. If land seemed appropriate for settlement, it was surveyed and divided into lots. The Homestead Act of 1862 allowed any person who was the head of a family or over age 21, and was a United States citizen or had declared the intention to become one, to secure a patent (deed) to 160 acres of the surveyed public domain. They could prove their claim by living on the land for five years, cultivating it, and making improvements.

Homesteaders, cattlemen, sheepmen, and other ranchers and farmers arrived in the area. They generally established their homesteads and other facilities on the lower slopes and along the main rivers and streams. Houses, barns, sheds, fences, and other improvements to the land were constructed to support year round occupation. Several of these homesteads remain in private ownership to this day along the upper Selway River between Paradise and Moose Creek.

By the late 1800s, communities outside the Selway and Middle Fork Clearwater subbasins (such as Elk City, Darby, and Hamilton) had been established to facilitate trade for miners and other settlers. By the early 1900s, "neighborhoods" developed in areas within the subbasins.

TWENTIETH CENTURY OCCUPATION AND FOREST SERVICE MANAGEMENT

BUREAU OF FORESTRY AND BITTER ROOT FOREST RESERVE

The U.S. Department of Interior's Bureau of Forestry, which became the Forest Service in 1905, became a presence in the area in 1897. This was to affect the character and subsequent development of the Selway and Middle Fork Clearwater subbasins thereafter. President Grover Cleveland designated all of the Lochsa-Selway country in Idaho, along with other lands in Montana as the 4,147,200-acre Bitter Root Forest Reserve in 1897. Starting in 1906, lands within the Forest Reserve could be authorized for homesteading only if they were valuable for agriculture. At this time, the General Land Office administered the forest reserve, while the U. S. Geological Survey performed the surveying and mapping efforts. John B. Leiberger of the U. S. Geological Survey created the first map of this region in 1898. The Forest Service secured land that suited its purpose for administrative sites and withdrew it from the public domain in 1907 and 1908.

One of the first rangers in this area was George Ring, who was appointed to the position in 1899. He was instructed to patrol for fires and to suppress any he discovered. His territory included what is now most of the Clearwater National Forest. As the fledgling Forest Service was developing, additional "rangers" were employed. Fighting fires was their main objective, but other projects were also undertaken. Ranger Ring began clearing trails, and in 1905 supervised the initial construction of the Selway Trail (Parsell, 1990).

FOREST SERVICE AND AREA NATIONAL FORESTS

In 1905, the Forest Service was an official agency. It was originally part of the Department of the Interior, and after much discussion and internal pressure the Forest Service (and the previously created reserves) was transferred to the Department of Agriculture. In 1907 Frank "Major" Fenn, a political appointee, oversaw the area.

By an act of congress, on March 4, 1907, the forest reserves were changed to national forests. On July 1, 1908, an executive order changed the Bitter Root name to Bitterroot, and the former Bitter Root Forest Reserve was divided into the Bitterroot, Nez Perce, and Clearwater National Forests (Biddison and Smolinski, 1988). In 1911, the fledgling Nez Perce National Forest was tapped for some of its land to create another national forest, the Selway (Cochrell, 1960, p. 102). As many as seventeen ranger stations were established in the region and included Pete King, O'Hara, Number One, Tahoe, Bear Creek, and Three Forks. Communication between these stations relied upon telephone lines, or on the rangers traveling on the trails by horse or on foot to the next closest station to relay news. These original ranger stations were simple log cabins where tools and other fire fighting equipment was stored, and where men were stationed during the fire season (Parsell, 1990). Today, few of the original ranger stations exist, since their functions have been combined into several larger offices where access is much easier than before.

SETTLEMENT AND DEVELOPMENT

By 1919, all the lands now in private ownership in the Lowell, Pete King and lower Selway areas were occupied. Life was difficult in this wild, remote country. Without commercial electricity, medical services, or teachers, the people of the Selway and Middle Fork Clearwater subbasins lived off the land and improvised to meet their needs. Settlers had to clear land before attempting any agricultural activities. Only the hardy could meet the challenge. After the Forest Service began building trails, cabins and telephone lines, things became easier. Seasonal jobs were available and many local people became the Forest's first employees and "managers." Today, most of these homesteads support recreation-based developments of some kind. Of those who struggled to homestead on land along the Selway and Clearwater Rivers, only one small parcel of land remains in the ownership of descendants of its original settlers (Parsell, 1990).

The U. S. government probably never thought that people would attempt homesteading in the distant lands of the Moose Creek area. A few men and women ventured deep into the backcountry where only the Nez Perce and a few prospectors and trappers had been before. Ten plots were patented starting in 1920, and ownership changed many times on most of those plots. The Wilderness Act of 1964 limited road building and access, and by 1976, the U. S. government had purchased all but four of the original homesteads. Four private inholdings, all served by airstrips, remain today.

More recently, other activities have been undertaken in the Selway River area. Numerous roads and trails were constructed in the area, and all eventually connected the existing ranger stations and adjacent communities together into a larger network of travel and communication routes. The first road up the Selway River was begun shortly after the Forest Service established permanent administrative sites there. A road between Goddard Bar and O'Hara Bar was blasted out in about 1911. By 1924, the Selway Road had reached O'Hara Ranger Station, and it reached Selway Falls in 1926. A road survey was made from Selway Falls to Moose Creek, but no money was available for that section (Parsell, 1990, p. 19). Surveys were completed for a railroad line as far as Pinchot Creek.

CIVILIAN CONSERVATION CORPS PROJECTS AND FACILITIES

During the 1930s, the Civilian Conservation Corps (CCC) established two camps along the Selway River and was instrumental in continuing the development of the region. In 1934, a seasonal tent camp was established at Glover Creek and the majority of enrollees stationed there originated from Chicago. Projects accomplished from this camp included the construction of steel bridges across the Selway River and Meadow Creek, and initial construction on Fog Mountain, Indian Hill, and Falls Point Roads. This camp was only used for two years and was replaced by the year round camp at O'Hara Bar (Parsell, 1990, p. 33).

The 200-man O'Hara camp was established in 1935 below the ranger station on O'Hara Bar. The enrollees built twelve new buildings at what is now Fenn Ranger Station, as well as bridges, roads, and telephone lines. They also did some trail and lookout construction and were an important part of the fire control organization. The O'Hara camp was eventually closed in 1942. The Forest Service used these facilities from 1942 to 1946. The buildings continued to be used into the 1960s until they became unsafe. In 1969, all the remaining buildings were burned (Parsell, 1990, p. 36).

LAND AND RIVER STATUS DESIGNATIONS

The flurry of activity to develop land, build roads and railroads, to harvest timber and develop wood products was curtailed by designating much Selway basin land as a primitive area in 1936, followed by the Wilderness Act in 1964. In 1968, the Wild and Scenic Rivers Act set guidelines to regulate how private and public lands would be developed or managed along the river corridors. The Selway, Middle Fork Clearwater, and Lochsa Rivers have all been designated as Wild and Scenic Rivers.

OTHER DEVELOPMENTS

Other developments have been made along the Selway River, including campgrounds that still exist today and a fish hatchery which only functioned until the early 1950s. Several campgrounds were established in the 1940s, and most of the rest were established in the 1950s and 1960s. The Boyd Creek Hatchery was built in 1938, failed due to water supply problems, and was closed in 1951. The concrete ponds were covered over, the buildings demolished or moved, and by the early 1960s the present Boyd Creek Campground was developed at the site.

PRIVATE RESIDENCES AND LANDS ALONG THE RIVER CORRIDORS

PRIVATE RESIDENCES

Three ownership patterns exist along the Selway and Middle Fork Clearwater River systems. They are: (1) an extensive length of continuous national forest ownership; (2) intermingled public, private and Native American land outside the national forest boundary; and (3) scattered small parcels of state and private lands within the national forest boundary.

The Wild and Scenic Rivers Act determines use within one-quarter mile on each side of the high water mark of the Selway, Middle Fork Clearwater, and Lochsa Rivers. Any lands that are adjacent to or can be seen within the corridor are also subject to the intent of the act, with "emphasis given to protecting ... esthetic, scenic, historic, archaeological, and scientific features" (Wild and Scenic Rivers Act, 1968). The Forest Service bought scenic easements for much of the land along the wild and scenic river corridors to assure that development would be well planned and that clean, clear water would remain. Those easements are specific to each individual property and delineate specific requirements regulating improvements, appearance, and development. A few landowners opted not to sell scenic easements to their property, and operate independently from the explicit terms of easement contracts.

One hundred and eighty single-family residences are allowed under easement on the Lochsa and Middle Fork Clearwater Rivers. Presently, more than 90 residences exist, and over 80 remain to be constructed. Along the Selway River, easements allow for 61 single-family residences. Thirty-eight have been built, and approximately 23 remain to be constructed.

PRIVATE LANDS

Four private inholdings exist within the Selway-Bitterroot Wilderness. The Seminole Ranch was patented in 1921. The land ownership has changed four times, and there is potential for development outside the requirements of a scenic easement there. The Selway Lodge, near the Shearer administrative site, operates under a scenic easement, and the Forest Service has a trail easement through the property. The North Star Ranch and the Running Creek Ranch on the upper Selway River have no scenic easements.

Traditionally, ranchers have owned and occupied land below the national forest boundary and in the Clear Creek area. Those ranches varied in size from 500 to 5,000 acres and were utilized for large herds of cattle and logging. Today, many ranchers have sold their ranches or subdivided their land. Cattle herds have been reduced to smaller numbers, and timber extraction is greatly reduced from previous levels. Those buying land and moving to the area include business owners, teachers, Forest Service employees, construction workers, and some people from areas outside of Idaho.

FOREST SERVICE ADMINISTRATIVE STRUCTURES AND FACILITIES ALONG THE RIVER CORRIDORS

RANGER STATIONS, GUARD STATIONS, AND ADMINISTRATIVE SITES

When the Interior Department's Bureau of Forestry became the U. S. Forest Service in 1905, the rangers of the Bitter Root Forest Reserve received instructions to select suitable administrative

sites. Homesteaders and miners were rushing into the lands the government had opened up for claiming, and the Forest Service needed to act quickly to establish strategic sites that "were reasonably accessible to the forests and the settlements, that had ample horse feed, a good water supply, and that were situated on either flat land or land with a gentle slope" (Schumaker, 1969). It was a large task, considering the area included all the land from the Lolo Trail to the Salmon River, and that it had been in a reserve where little or no development or change from a primitive state had occurred.

In order to administer the remote lands of the four national forests (Bitterroot, Nez Perce, Clearwater, and Selway) that had been created in the Selway and Middle Fork Clearwater subbasins by 1911, the area was divided into several districts. District boundaries were reformed, combined, or otherwise changed as necessary to meet management needs. As many as seventeen ranger stations and guard stations were established throughout the districts. Some of those sites served as various district headquarters, and although others were never officially district offices, they served as a base of operations or shelters for passing Forest Service personnel for a short while. The most prominent ranger stations were Bear Creek, which later was moved to Shearer; Moose Creek; O'Hara; Number One; Pete King; Meadow Creek; Fenn; and Selway Guard Station. The Magruder and Paradise sites were important to Forest Service administration in the eastern portion of the assessment area.

Some ranger stations were abandoned and others were burned or moved. O'Hara was district headquarters for the Selway District until 1940, and the buildings there were named to the National Register of Historic Places. The ranger's residence there accidentally burned in 1991. Station Number One (after 1909, named the Middle Fork Ranger Station) was located at the present junction of Smith Creek Road and Highway 12, which at that time was at the end of the road. It was an important supply distribution center and bustling administrative site. Its usefulness became less significant as road construction continued up the Middle Fork Clearwater toward Montana. After the site was abandoned, the buildings were destroyed except for the main cabin, which was moved to a resort in Lowell and now serves as a bed and breakfast unit. The Pete King Station was built in 1916, in the vicinity of Lowell, which is now located along Highway 12. It was a supply headquarters for the Selway Forest and the Middle Fork District until 1924, when it was supplanted by the Idaho Department of Transportation, and the Forest Service buildings were burned.

Seven remaining stations presently serve two national forests and three districts.

Bear Creek and Shearer

Bear Creek could have been the earliest station constructed. The date is uncertain, but there was Forest Service activity there in 1910. Other buildings were built there in 1916, when Bear Creek became a district, and another was added in 1922. Bunkhouses were built in the early 1930s. When Bear Creek and Moose Creek Districts combined in 1934, Bear Creek became a guard station. Sometime after 1960, two buildings from Bear Creek were moved to Shearer, three miles away, and are used as Forest Service administrative sites today. In 1988, plans were made, but not carried through, to keep an attendant there. There are no good records to verify visitor use at Shearer, but air traffic and use by outfitters and other members of the public have increased, according to observations by pilots, Forest Service personnel, and recreationists.

Three Forks and Moose Creek

The abandoned Shissler cabin was standing at Three Forks (near the confluence of the East and North Forks of Moose Creek), in the heart of the Moose Creek country, when Forest Service crews passed through the area in the early 1900s as they built trails to outlying parts of the Forest. It was a convenient stopover, and became known as a ranger station. It is shown as such on a 1911 Selway Forest.

When the new Moose Creek District was established in 1920, the ranger, Jack Parsell, moved headquarters to the present site of the Moose Creek Ranger Station, about five miles downstream from Three Forks, and built a large combination cookhouse and administrative office building. Among buildings added were: a ranger's house, bath house, warehouse, tool storage shed, woodshed, fire cache, residence, gas house, chlorinator house, saw filing shed, bunk houses, and parachute loft. Most of those buildings remain today.

Both Moose Creek and Bear Creek Districts were administered from Moose Creek after 1932. That year an airstrip was built at Moose Creek, and a longer, 4,100-foot field was added in 1957. Moose Creek became a work center and administrative site when the offices were moved to Grangeville, year-round, in 1970. From March to November, a pack string supplies the station about once every week when wilderness rangers, administrators, construction crews, and trail crews work out of the station. The Moose Creek Ranger Station is on the National Register of Historic Places, and is maintained to perpetuate the rustic character of the 1920s. Propane lights have been added to some buildings. There is a Remote Weather Observation Station (RWOS) located on the site.

Meadow Creek

Meadow Creek Ranger Station was built around 1924, and replaced Anderson Butte as an administrative office. It was in operation for about ten years, under the direction of one district ranger during the entire period. The Forest Service nearly burned it in the 1960s, but decided instead to restore it. Today, one of the two cabins at the site is available for use by Forest Service trail crews and other Forest Service personnel. A cabin is also available as a rental unit for visitors.

Selway

The Selway Guard Station was built in 1907, at the end of Selway River Road where it met Fog Mountain Road. When the road was extended to Selway Falls, the cabin was dismantled and moved to its present location. It continues to serve as a packing station for trips into the upper Selway area. It has also served as a visitor information center and backcountry ranger base station.

Fenn

The Bitter Root Forest Reserve took over abandoned buildings and land at Goddard Bar in 1902. When it was decided that the Forest Service would not establish an administrative site there, the agency proposed to exchange 35 acres of that land for land within the Clearwater National Forest owned by the Clearwater Timber Company. The Water Power Act of 1920 would not allow the Forest Service to dispose of the land because it was a potential hydroelectric power site. Nine years later, the Civilian Conservation Corps (CCC) began construction of Fenn Ranger Station at that site. The Fenn Ranger Station was built to accommodate the Selway and the Middle Fork Ranger Districts, and employees from the Pete King, Number One and O'Hara Ranger Stations moved there in 1935. It remained the Selway District Ranger Station after the Middle Fork District was discontinued in 1956. Since the Selway and Moose Creek Districts combined in 1995, it has served as headquarters for the Moose Creek Ranger District. It was named to the National Register of Historic Places in 1990. When it was built, it served as a model for the modern ranger stations that would replace the original log structures. It is still considered a showplace, and is a classic station set on a serene flat overlooking the Selway River.

Since Fenn Ranger Station was built to accommodate two ranger districts, two residences were built on the compound to house the respective district rangers. A third house was moved from the Boyd Creek Fish Hatchery in 1962 and placed next to the ranger dwellings. Moose Creek District employees, including the ranger, have since occupied those homes. Other housing for district employees is available in four trailer homes that have been installed within one-half mile of Fenn Ranger Station and at Cedar Flats (Parsell, 1990).

Magruder

The station began as a tent camp prior to 1919, and a road along Deep Creek was built to service the area after the widespread forest fires of 1910 and 1919. It was first known as the Deep Creek Ranger Station when an office/residence and ranger's house were built. The CCC added a barn, corral, and woodshed, and the name was changed to Magruder Ranger Station. The original road was improved in 1936 and Magruder was connected to Elk City by a one-lane road. Today, the ranger's house is used as a rental site for forest visitors and the other buildings serve as an administrative site for the West Fork Ranger District. Magruder is on the National Register of Historic Places.

Paradise

Paradise Guard Station, barn and corral were built in the 1920s. The site is located at the end of Paradise Road 6223, and serves as a portal to wilderness trails and the launch site for river rafting on the Selway River. A large outfitter camp operates year round nearby. West Fork District trail crews and field personnel base at the station during the summer work season.

LOOKOUTS

The disastrous fires of 1910 forced the fledgling Forest Service to reorganize forest boundaries and to find better ways to deal with finding and fighting fires. Men who worked out of backcountry stations were sent to the mountaintops where they stayed in tent camps for the entire summer. Supplies came to them by pack strings. Lookout "towers" were usually trees, and the lookout men communicated by heliograph and the nearest phone, which was often several miles away.

By 1916, lookout buildings began to replace tent camps, and at the zenith of the lookout era there were over 200 lookout stations in the Selway country (Kresek, 1985). Phones were installed in ranger stations and connected by miles of telephone wire to phones in selected lookout towers, and crews constructed roads and trails to the summits where the lookouts were located. Lookout men not only found fires, they hiked miles to fight them. They also maintained trails and phone lines.

After the peak of lookout construction activity in 1939, the use of and need for lookouts declined. Men were sent to the war (in many cases, women were assigned to replace them); airplanes, sophisticated radios and video cameras, infrared sensing, and weather reporting satellites became more widely used to detect and fight fires; and so began the extinction of the legendary fire lookouts. The need for the dependable, dedicated lookout person was nearly eliminated.

The Forest Service eliminated all but 21 of the lookouts in the Selway area. Some lookouts were merely abandoned, but most others were considered hazardous and the Forest Service burned them during the 1960s and later. Today, only seven staffed lookouts exist in the Selway basin. On the Nez Perce National Forest they are: Gardiner, Shissler, Indian Hill, and Coolwater Lookouts; on the Bitterroot National Forest Salmon Mountain, Spot Mountain, and Hell's Half Acre Lookouts remain staffed. Eight other lookouts are still in place, and three of those are used only for emergency situations. The Lookout Butte site is maintained as a rental for the public.

Now the Forest Service is reconsidering the value of lookouts. Fixed area observation has some advantages. Lookouts are in a position to observe fire activity all day and night, compared to the few minutes an observer in an aircraft has as the craft passes over. Lookout stations are often portals to the wilderness and receive many visitors. Lookouts can supply geographic and historic information as well as education about fire and wilderness. Lookouts are a connection to the past, present and future of the forest. People see the lookout as a symbol of the old Forest Service, of heroes and adventure, and of dedicated, hardy people who worked on the land (Crawford, 1999). The merit of lookout stations is evidenced by the fact that some forests (in Oregon, for example), are building new structures for fire observation.

RECREATIONAL FACILITIES

Campgrounds

Developed campgrounds along the Selway and Middle Fork Clearwater Rivers and the Magruder Corridor (see Map 55) are popular among all recreational user groups. The accessibility offered by roads facilitated the development of sites that were considered favorite spots by hunting enthusiasts, tribal members, and cattle and sheep owners. Civilian Conservation Corps groups improved and used many of these sites in the 1930s, and since then they have developed into campgrounds offering a range of facilities, from toilets and picnic tables to trailer spaces and hookups for recreational vehicles.

Campgrounds and road conditions along the 16-mile stretch of Selway River Road 223 reflect a transition from a rural to a primitive recreational opportunity setting. Most campgrounds within the basin are available for use on a first-come, first-served basis; only a few require fees or reservations. Riding and pack animals are allowed in most sites along the Magruder Corridor and the Selway River. Stock facilities (loading docks, water tanks, and feed bunks) are provided in several sites. Developed sites along the Selway River have been hardened and renovated, and some are being made handicapped-accessible in a four-year project, which was started in 1999 and is expected to be finished in 2003.

Use records for some years are available for some sites along the Selway and Middle Fork Clearwater Rivers, covering the time from the week before Memorial Day through the week after Labor Day. An increase in use of the campgrounds along the Selway River could occur with the Lewis and Clark Bicentennial event. If such an increase in use occurs, a sign to indicate campground occupancy will be provided within the first mile of Selway River Road 223, and increased agency presence would be necessary. Currently, one recreation technician monitors visitor use, provides education, and supplements law enforcement during use seasons. Vandalism and resource damage have remained static over the past ten years.

LAND USES

NEZ PERCE TRIBE LAND USE TREATY RIGHTS

Historically, the Nez Perce Tribe was one of the largest groups of native people within the Columbia Plateau region of the Pacific Northwest. The tribe occupied lands over 13 million acres that included all of the Clearwater River drainage, the Wallowa Mountains, and the upper portions of the Salmon River drainage. The first treaty between the United States and the Nez Perce people was signed on June 11, 1855, establishing a 7.7 million acre reservation.

In 1860, gold was discovered within the Nez Perce Reservation near present-day Orofino. This discovery resulted in a massive influx of miners, which led to conflicts and disputes between the Nez Perce and the Euro-Americans. The United States sought to negotiate another treaty. This treaty reduced the size of the Tribe's reservation. Although the treaty was resisted by several Nez Perce leaders, it was ultimately executed on June 9, 1863. The reservation was reduced to about 780,000 acres.

A third treaty between the Nez Perce Tribe and the United States was formalized on August 13, 1863. One of the provisions in this treaty was the allotment of lands within the reservation to individual tribal members.

In 1887, the General Allotment (Dawes) Act established mandatory allotments of reservation lands. Individual parcels were divided among tribal members, usually in amounts deemed sufficient to practice an agricultural way of life. After allotting lands to tribal members, the remaining areas were opened to homesteading or purchase by settlers.

WILDERNESS

The process of the United States entering into treaties with Native American tribes was terminated by an act of Congress in 1871. However, formal agreements between the United States and Native American tribes were still needed. In an 1893 agreement, the Nez Perce ceded all the unallotted lands within the limits of their reservation to the United States. The allotment process affected tribal land holdings, resulting in a checkerboard pattern of land ownership within the reservation. Today, the allotted lands make up the majority of the reservation lands. Presently, the Tribe and tribal members own about 90,000 acres of the 780,000-acre reservation created in the Treaty of 1863. None of the subsequent treaties between the United States and the Nez Perce people altered or affected the rights reserved in the original 1855 treaty, except for the lands reserved and ceded.

WILDERNESS

The Selway and Middle Fork Clearwater subbasin assessment area covers 1,394,613 acres. Of that, approximately 72 percent (about 1 million acres) is roadless or designated wilderness. The Selway-Bitterroot Wilderness (SBW) and a portion of the Frank Church-River of No Return Wilderness (FCRONRW) make up a large portion of the assessment area.

The Selway Bitterroot Primitive Area was established in 1936, and was being managed much as a present-day wilderness in 1939 under USDA regulations. The National Wilderness Preservation System Act was passed in 1964 and the Selway Bitterroot Primitive Area, minus 635,000 acres, became the Selway-Bitterroot Wilderness.

The Wilderness Act of 1964 challenges agency managers "to secure for the American people of present and future generations, the benefits of an enduring resource of wilderness." The act states in section 2 (c) (2) that wilderness "has outstanding opportunities for solitude or a primitive and unconfined type of recreation." Section 2 (c) (1) notes that wilderness "generally appears to have been affected primarily by the forces of nature."

The Wild and Scenic Rivers Act of 1968 ensured that the Selway, Lochsa, and Middle Fork of the Clearwater Rivers would remain wild and free-flowing even though they flow beyond and outside of designated wilderness boundaries.

SELWAY-BITTERROOT WILDERNESS MANAGEMENT

After the Selway-Bitterroot Wilderness was established in 1964, about eleven years of transition passed before a SBW management plan was put in place. In 1982, the plan was revised and renamed the *Selway-Bitterroot Wilderness Management Direction*, and included as an appendix in the forest plan of each of the four forests (Nez Perce, Bitterroot, Lolo, and Clearwater) responsible for SBW administration. In 1992, the *Management Direction* was further revised to incorporate recreation, trails, and airfields. In 1996, the plan was amended to combine forage and vegetation sections that also addressed weeds. That plan provides the current management direction for the SBW. Other sections, including special use permits, were intended to be included in the *General Management Direction*, but the wilderness planning group dispersed before those sections were completed.

A Forest Service SBW leadership structure was established to facilitate consistency in quality management, and to coordinate decision-making and forest plan implementation to meet the management challenges presented by a wilderness that encompasses four national forests and seven ranger districts. The Coordination Team is made up of: the Leadership Policy Council, which includes the forest supervisors of the Bitterroot, Clearwater, and Nez Perce National Forests; the steering group, consisting of area district rangers; and the Implementation Team, which is made up of the resource assistants in each district. A wilderness coordinator position was created to serve as advisor to the steering group and staff; this position has been vacant since 1997 due to lack of wilderness funding.

In 1987, a Citizens' Task Force was appointed to formulate management recommendations and a framework to portray the desired future condition of the SBW using the limits of acceptable change (LAC) planning system. "The [LAC] planning concept melds the expertise of managers, specialists, and researchers with the perspective and first-hand knowledge of all user groups to develop workable management direction" (*SBW Management Direction*, 1992). The dynamic LAC process is an ongoing cycle: plan, implement, monitor, and evaluate. See Appendix G for a detailed explanation of the nine-step LAC process and definitions of opportunity classes.

Together, the SBW Coordination Team and Citizens' Task Force addressed how recreation and other resources should be managed to assure the ongoing character of the wilderness. The groups considered wilderness elements such as trails management, visitor management, and aircraft and airfield management. Areas within the SBW were classified into four different opportunity classes and are managed to meet the limit of acceptable change prescribed for each designated opportunity class. Descriptions and indicators of the desired resource, social and managerial setting for each opportunity class are found in Appendix G. A monitoring plan requires completing a baseline inventory on each wilderness campsite and trail, and that all sites be monitored on a five-year rotation. That work is complete on some districts, and partially complete on others. An annual State of the Wilderness report (SOW) is compiled, and areas that do not meet LAC standards and forest plan management direction are listed. Management decisions are made to attempt to improve those areas and move them toward the desired future condition.

In 1994, 127 campsites and trails did not meet forest plan LAC standards; in 1995, 186 sites and trails did not; and in the 1999 SOW, 132 sites or trails in the SBW were listed as out-of-standard or problem areas. The most recent reports do not necessarily reflect conditions on the ground because many sites are not systematically visited or monitored. Extensive and consistent monitoring is difficult because the SBW is large and campsites are scattered and remote. Budget constraints have limited the numbers of wilderness field people and wilderness rangers available to accomplish monitoring in the field, rehabilitation work at out-of-standard sites, and office work such as recording and analyzing data, map making, and planning. Also, the window of opportunity for reaching some sensitive areas is very small because of weather conditions at higher altitudes.

The LAC Citizen Task Force discontinued input into SBW management in 1996, and the wilderness coordinator position was eliminated because of a limited wilderness budget in 1997. Wilderness leadership became the responsibility of the involved District Rangers on a rotating basis.

Wilderness Fire Policy

The Selway-Bitterroot Wilderness was the first wilderness area in the Forest Service to allow natural fires to burn freely. Forest Service pilot programs were started in the White Cap Creek and Bear Creek drainages. The SBW has been under a wilderness fire plan since 1976. Fires have been allowed to burn in the SBW every year since, except 1989, when all wilderness fire plans were revised to meet new direction in response to the controversial 1988 fire season. The Frank Church-River of No Return Wilderness Fire Management Plan was initiated in 1985, and has remained in force except for in 1989.

Fire has been allowed to play its natural role in the Selway-Bitterroot and Frank Church-River of No Return Wildernesses to a greater extent than in any other wilderness in the lower 48 states. Fires have been allowed to burn to replicate natural processes. However, not all fires are allowed to burn, and every fire must meet strict prescription criteria. Fires that threaten life and property, or threaten to escape wilderness boundaries are suppressed. During periods of preparedness levels IV and V (high fire activity and high demand for fire-fighting resources), regional and national level Forest Service authority is applied, and fires are usually suppressed if resources are available.

FRANK CHURCH-RIVER OF NO RETURN WILDERNESS MANAGEMENT

In 1980, the Congress created the River of No Return Wilderness with passage of the Central Idaho Wilderness Act. In 1984, the late Senator Frank Church's name was added. The Bitterroot National Forest manages that small portion of The Frank-Church River of No Return Wilderness (FCRONRW) within the Selway subbasin. Managers use the recreation opportunity spectrum (ROS) as a tool for wilderness recreation planning and the Frissell and Cole methods for inventorying numbers and condition of recreation sites. A management plan that recognizes a need for change is being drafted to address new issues that have emerged since the 1984 FCRONRW plan was approved. Decisions will be made in all resources on which goals, objectives, indicators, standards and monitoring requirements to adopt (*FCRONRW Draft Environmental Impact Statement*, 1998).

NATIONAL WILDERNESS MANAGEMENT ISSUES AND POLICIES

The focus on wilderness issues at the national level will affect wilderness management decisions in the SBW and the FCRONRW. A Forest Service Chief's Advisory Group was appointed in 1999 to develop strategies to meet the broad goals of the *Interagency Wilderness Strategic Plan* of 1995. In 2000, the Advisory Group's strategies were compiled in a document called *Contemporary Agenda for an Enduring Resource of Wilderness: Thinking Like a Mountain*. The wilderness agenda in that document is organized around six major emphases critical to improving Forest Service ability to manage the wilderness resource: (1) education, training and outreach; (2) wilderness inventory and monitoring; (3) information management; (4) priority resource issues (air quality, water quality, recreation use, native fish and wildlife, exotic species, fire, ecosystem restoration, rangeland and grazing, and private land interests); (5) program management and coordination; and (6) leadership. Also, in January 2001 the Forest Service Chief announced that a national wilderness director will be appointed, 100 wilderness stewards will be funded, and a commitment to funding wilderness and river rangers will be made to assure that they are on the land and the water.

RECREATION

Recreational use of the Selway and Middle Fork Clearwater subbasins is significantly increasing and becoming more diversified. Seventy-two percent of the area in the subbasins is designated wilderness and roadless, and continues to attract visitors seeking special places and experiences. Recreational activities and use patterns are changing.

Traditionally, recreation has been principally seasonal. In summer and early fall, local residents enjoyed hunting, fishing, berry picking, horse and mule pack trips, family camping and outings, hiking and backpacking. Non-residents began coming into the subbasins to visit the backcountry and wild rivers as national and worldwide attention was focused on the unique natural attractions. Commercial recreation services flourished and offered experiences in river rafting, kayaking, hunting, and fishing. Backcountry and wilderness airstrips receive moderate to heavy use. There is a waiting list of those who want to rent cabins and lookouts that are available for public use.

While traditional activities are still popular, the public is demanding more diversified opportunities. River rafting, mountain biking, rock climbing, history, wildlife watching and photography trips are steadily gaining popularity. Year-round recreation evolves as the public seeks more trails and opportunities for off-highway vehicle (OHV) use, snowmobiling, skiing, and snowboarding. Motorized vehicle use (OHVs, motor homes and campers) is expected to significantly increase. Hang gliders and yet-to-be-invented devices will likely show up as enthusiasts expand their horizons to include pristine or little explored, less populated places.

Visitors to the Selway basin can be divided into two significant groups. One group includes regional residents from areas within a three-hour drive, including Lewiston, Moscow, and Boise in Idaho; Clarkston, Pullman, and Spokane in eastern Washington; and Missoula and the Bitterroot

Valley in Montana. These visitors come for both weekends and for extended periods of time (up to two weeks). Some of these visitors prefer the Highway 12 and 95 corridors for the higher development levels of the roads and for the private and public sector recreation facilities, but many prefer the numerous dispersed opportunities and less-developed sites found in the canyons and on the ridges away from the Highway 12 and 95 corridors. These visitors utilize the area several times each year, often for different recreation objectives, depending on the season. The second group includes people from areas such as Minneapolis, California, Nevada, Utah, Seattle, Portland, and Colorado. These visitors typically visit once each year and usually for a special interest such as rivers, wilderness and backcountry, hunting, or solitude opportunities (*Northern Region Recreational/Tourism Assessment & Strategy*, 1994).

Visitor use in the Selway and Middle Fork Clearwater subbasins is difficult to accurately assess. There is no permit system in place except for hunters and anglers (licenses issued through the Idaho Department of Fish and Game and the Montana Department of Fish, Wildlife, and Parks), and Selway River float use. Two campgrounds record visitor use. Numbers of aircraft that land at backcountry fields are not closely monitored, with the exception of Moose Creek. Visitor use is expected to increase as tourists celebrate the bicentennial of the Lewis and Clark expedition through 2005.

ROADLESS AREAS

There are two inventoried roadless areas within the Middle Fork Clearwater subbasin and four inventoried roadless areas within the Selway subbasin. A summary of the management emphases for these roadless areas is shown in Tables 4.1 and 4.2 below. None of the inventoried roadless areas on the Nez Perce National Forest were recommended for wilderness designation.

Table 4.1: Management Emphases for Inventoried Roadless Areas in the Middle Fork Clearwater Subbasin

Roadless Area Name and Number	Size in Acres	Primary Management Emphasis from Forest Plan
Middle Fork Face #1842	10,170	A management combination of timber production, visual quality and big game winter range forage production. The Middle Fork Clearwater Wild and Scenic River corridor makes up the entire northern boundary of this inventoried roadless area.
Clear Creek #1844	11,876	A management combination of big game winter range forage production and timber production.

Table 4.2: Management Emphases for Inventoried Roadless Areas in the Selway Subbasin

Roadless Area Name and Number	Size in Acres	Primary Management Emphasis from Forest Plan
Rackliff-Gedney #1841	90,173	Increase forage on potential big game winter range and manage for timber production while improving potential deer and elk winter range.
O'Hara-Falls Creek #1226	25,326	A management combination of increasing forage on potential big game winter range and timber production. The O'Hara Creek Research Natural Area is located within this roadless area.

ROADLESS AREAS

Roadless Area Name and Number	Size in Acres	Primary Management Emphasis from Forest Plan
West Meadow Creek #1845C	107,512	This large roadless area contains about 10 management areas. The three management emphases that are most often represented are timber production, maintain visual quality, and big game winter range forage production.
East Meadow Creek #1845D	94,203	Manage to provide for high quality fish and wildlife habitat and water quality. Provide opportunities for high quality, semi-primitive, dispersed recreation. Lands are classified as "unsuitable" for timber production. Defer timber harvest and road construction.

Since the forest plan went into effect in October 1987, four timber sales have been harvested in three of these roadless areas. An estimate of the effects of these timber sales is shown in Tables 4.3 and 4.4, below.

Table 4.3: Timber Harvest and Road Construction in Inventoried Roadless Areas in the Middle Fork Clearwater Subbasin Since 1987

Roadless Area Name and Number	Size in Acres	Timber Harvested Since 1987?	Roadless Area Cutover Acres	Roadless Area New Road Construction Since 1987
Middle Fork Face #1842	10,170	Yes	549	None, all helicopter logged.
Clear Creek #1844	11,876	Yes	150	3.9 miles

Table 4.4: Timber Harvest and Road Construction in Inventoried Roadless Areas in the Selway Subbasin Since 1987

Roadless Area Name and Number	Size in Acres	Timber Harvested Since 1987?	Roadless Area Cutover Acres	Roadless Area New Road Construction Since 1987
Rackliff-Gedney #1841	90,173	Yes	359	None, all helicopter logged.
O'Hara-Falls Creek #1226	25,326	No	0	0
West Meadow Creek #1845C	107,512	No	0	0
East Meadow Creek #1845D	94,203	No	0	0

OUTFITTING AND GUIDING

Early outfitters in the Selway country catered almost exclusively to hunters. Following World War II, outfitters and guide services expanded as recreational use increased. Outfitters were not required to hold permits and operated independently of direction or management by federal or state agencies. There were few restrictions and no boundaries for areas of operation. The leave-no-trace concept and the minimum impact ethic were not well known, and favorite camping spots received continued, heavy use. Structures and caches appeared. Fences, corrals, water systems, and toilets were constructed, and large groups of people and stock with heavy tents and cookware were common. Garbage dumps, tree stumps, exposed roots, overgrazed meadows, compacted soils, and polluted water were left behind (*Outfitter-Guide Administration Guidebook*, 1997).

The Idaho Outfitters and Guides Association was established in 1954, and outfitters came under the jurisdiction of that agency, federal agencies, and state fish and game licensing boards. The Idaho Outfitters and Guides Licensing Board issues permits to outfitters who are governed by the bylaws of the Idaho Outfitters and Guides Association (IOGA). Outfitters who operate on national forests are also responsible to the authority of an operating plan. The outfitter, IOGA, and the Forest Service cooperate to develop an outfitter operating plan that is administered by the Forest Service (see Map 57 for outfitter and guide camp locations). The Idaho Department of Fish and Game allots game tags to outfitters, and state hunting regulations apply. The Wilderness Act of 1964 and increased visitor use brought attention to developing ways to use the backcountry with less impact. Diversified activities opened new opportunities for outfitting, including river float trips, fishing, and photography trips. Agencies, special interest groups and some outfitters pioneered the new low-impact ethic, and espoused the "pack-it-in, pack-it-out" philosophy. Outfitters must comply with specific land-use guidelines as outlined in their permits and the Code of Federal Regulations, and must be in compliance with wilderness use standards as prescribed by forest plans.

Nineteen non-river outfitters in the Selway and Middle Fork Clearwater subbasins offer traditional (hunting and fishing) services. Fees for operation on public lands are assessed by the Forest Service and are based on three percent of each outfitter's gross earnings. That revenue is appropriated for outfitter-related administration, to improve trails, and to generally benefit outfitter operations. Information from district outfitter and guide files from 1995 to 1998 refers to average total outfitter use, not average use per outfitter. It indicates that combined outfitter use in the assessment area (Nez Perce and Bitterroot National Forests) averaged 5,395 client use days per year. Combined outfitter average gross annual revenue for that period was \$1,478,460. Three percent of the combined gross earnings paid to the Forest Service for operation on federal lands averaged \$44,354 per year. Ninety percent of outfitter clients are from outside of Idaho, and about two percent of the hunting public uses outfitter services. Outfitted clients have a higher hunting success rate than the regular public (Goosman, 2000). Four river outfitters offer one launch a day for rafting and kayaking parties on the Selway River. Illegal outfitter operations exist, but are difficult to identify and prosecute.

Focus is gradually changing from traditional outfitting to diversified activities, ranging from fitness trips to historical interpretation tours. As fish and game agencies cut back on licenses and tags to address the decrease of some game populations, outfitters and guides must increase fees and/or look for a new kind of customer. There is an increasing demand by outfitters for fishing. Institutional outfitting is on the increase. Outward Bound, the National Outdoor Leadership School (NOLS), and university groups seek educational opportunities and adventure. There is no charge or minimal fees for these groups. The Lewis and Clark Bicentennial is expected to greatly impact those outfitters that border or have areas near U. S. Highway 12. The changing trends in recreational use are impacting outfitters, who will need to meet the challenge of offering and marketing diversified services.

FOREST PRODUCTS GATHERING

Although there are occasional lapses in low-impact land use techniques, most outfitters are improving their efforts in this area. Most want to be perceived as caretakers of the land, by both the public and the Forest Service.

MINING

Part of the reason that the Selway and Middle Fork Clearwater subbasins remain largely undeveloped is that valuable mineral deposits were not found there by prospectors in the 1800s, and have not been found there since. Also, large tracts of land were withdrawn from mineral entry through the Wilderness Act of 1964 and the Wild and Scenic Rivers Act of 1968.

The geology of the areas surrounding the Selway and Middle Fork Clearwater subbasins is rich in gold and other valuable metal, especially the area around Elk City. The first major gold discoveries in the Elk City and Pierce areas occurred in 1861, but there has never been a major discovery or even a minor producing mine in the Selway and Middle Fork Clearwater subbasins.

Several metals of interest have been found in the subbasins in limited quantities, including: gold, kyanite, talc, iron, titanium, cobalt, and nickel. None of these mineral finds went beyond the prospecting stage, and the minerals did not occur in economically viable deposits. These minerals require sizeable deposits to merit development.

In the area around Green Mountain Lookout, there were some copper prospects investigated by a company in the late 1960s. The company built approximately 22 miles of road near Granite Peak, and did both trenching and core drilling. Since then, the Forest Service has attempted to seed the roads, and has blocked them from public use. There is some interest in copper near Green Mountain, but nothing of the size required for development has been found.

FOREST PRODUCTS GATHERING

NON-TIMBER

Roots, berries, trees, shrubs, mushrooms, edible and medicinal plants, nuts and herbs are found throughout the subbasins. People within and adjacent to the assessment area utilize these products for personal use, and some use them for commercial purposes. Members of the Nez Perce tribe collect trees, plants, roots and berries for traditional uses. Commercial gathering of forest products is prohibited within wilderness areas.

Within the subbasins, gathering non-timber forest products for recreational or personal use is not regulated, and data regarding the demand for these products and the types and amounts available does not exist. However, according to anecdotal information from forest workers' encounters with individuals participating in non-timber forest products gathering, participation in such activities can be characterized as being low. Gathering mushrooms and berries seems most dominant. Future demand is expected to remain low.

Collection of non-timber forest products for commercial purposes is regulated and requires a permit. Most commercial collection permits are issued for wild mushrooms and floral greens. The number of commercial permits issued is very low and seldom exceeds one or two permits every few years. The low demand for commercial permits can be attributed to the fact that there is not a local wholesaler or collection point for the various forest products. It is predicted that future commercial demand for these products will remain low. Periodic increases in commercial demand for specific products may occur in the future.

An exception to the low demand for commercial non-timber forest products permits involved the collection of Pacific yew bark that occurred in the early 1990s. Several commercial permits were issued throughout the Selway and Middle Fork Clearwater subbasins for the collection of this material. Pacific yew bark was used in the production of the anti-cancer drug taxol. Demand for

Pacific yew bark significantly decreased when a synthetic substitute was developed. There are currently no commercial permits issued for Pacific yew bark collection.

TIMBER-RELATED

Timber-related forest products such as cedar shakes, posts and poles, and fuel wood are also gathered throughout the Selway and Middle Fork Clearwater subbasins. Collection of these materials is prohibited in wilderness areas and is generally confined to areas within close proximity of travelable roads.

The Selway basin has a high occurrence of cedar habitat types, and the collection of cedar trees for manufacture into roofing shakes, fence rails, and fence posts for personal and commercial use occurs. Collection of these materials is regulated and permits are required for personal and commercial gathering. The demand for post and pole material is greater than that for roofing shakes, and the demand for cedar products in general varies considerably from year to year. The Fenn and Lochsa Ranger Stations typically issue less than 10 permits each annually, allowing the removal of 20 to 30 cunits (one cunit is approximately 100 cubic feet). These permits are mostly for personal use. Future demand for these products will likely follow current trends, continuing to vary from year to year.

Fuel wood gathering is important for heating the homes of many people living within and adjacent to the assessment area. Fuel wood for commercial and personal is one of the most common forest products taken from the area. Commercial and personal fuel wood gathering is regulated and permits are required to remove this product from the forest. Permits for fuel wood removal allow the holder to gather fuel wood on any forest within the Forest Service's Northern Region. Given this consideration, it is difficult to determine the amount of fuel wood actually removed from the Selway and Middle Fork Clearwater subbasins. Approximately 30 permits are issued from the Fenn Ranger Station and 200 permits are issued from the Lochsa Ranger Station annually for personal use. Given an average of three cords per permit, and assuming all the Fenn permits and about 50 of the Lochsa permits are used to collect fuel wood within the Selway and Middle Fork Clearwater subbasins, this would amount to approximately 240 cords of fuel wood removed annually.

Fuel wood gathering is considered a commercial venture when the wood will be sold. Hiring help to cut and gather personal use fuel wood is not considered a commercial venture, even though money is exchanged. Very few commercial fuel wood permits are currently issued within the Selway and Middle Fork Clearwater subbasins. An occasional permit may be issued for approximately one to five log truck loads of fuel wood (5 to 50 MBF or 10 to 100 cords). Just one to two of these commercial permits may be issued every few years, and they typically are issued for areas with dead trees that have succumbed to wind, insects or disease and are accessible by road.

TIMBER HARVEST

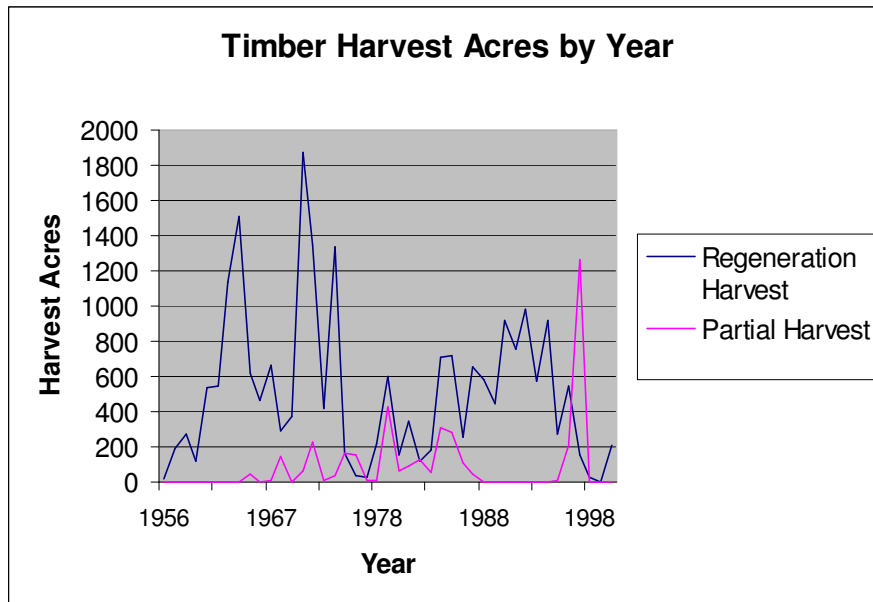
As early as 1890, cedar logs were cut and floated down the Selway River and sold. The first advertised timber sale was in the area of Smith and O'Hara Creeks in 1913. By 1923, the Selway Forest had a full-time timber sale administrator working on sales in the Smith Creek area, but little quantitative data are available. By 1956, logging activity was intense on the ridge tops above the north side of the lower Lochsa River, the south side of the lower Selway River, and both sides of the Middle Fork Clearwater River. Timber sale preparation and administration, along with road design and construction, became the major Forest Service activities from the 1950s through the 1980s, and the wood products industry became the area's largest employer.

Figure 4.1 displays numbers of annual timber harvest acres for the Nez Perce and Clearwater National Forests in the Selway and Middle Fork Clearwater subbasins, so far as they are known, from 1956 to 2000. Some harvest occurred in the 1930s as well, but is poorly documented.

LIVESTOCK GRAZING

Harvest activity peaked in 1970, when over 1,800 acres were logged, using mostly clearcut methods. Clearcut opening size also peaked during this time at about 90 acres. Average opening size declined to about 20 acres in the 1990s. A total of 22,420 acres of land have been affected by regeneration harvest on the two forests within the Selway and Middle Fork Clearwater subbasins, and 3,859 acres have been subject to partial harvest. From the 1930s through the 1980s, partial harvest, including thinning and some salvage, occurred at relatively low levels compared to levels of that type of harvest in the 1990s.

Figure 4.1: Timber Harvest Acres by Year within the Selway and Middle Fork Clearwater Subbasins on the Nez Perce and Clearwater National Forests



Large areas of the Selway subbasin have been withdrawn from timber harvest activities through the creation of the Selway-Bitterroot and Frank Church-River of No Return Wilderness areas and the designation of numerous roadless areas.

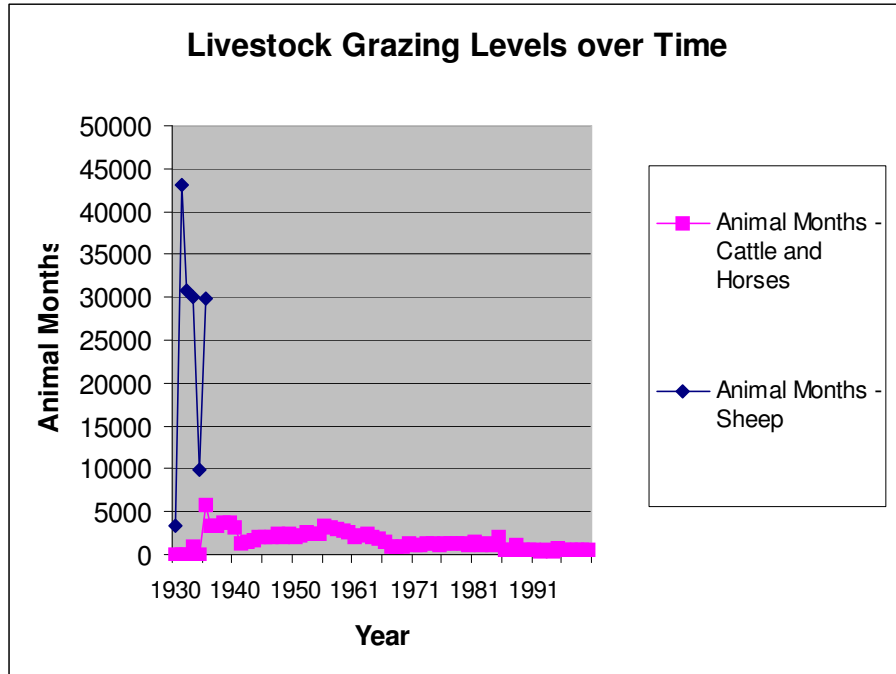
LIVESTOCK GRAZING

Livestock grazing began with the earliest travelers and settlers, but grazing is not well documented prior to about 1930. The forest fires of the early twentieth century resulted in abundant sheep and goat range for several years. Figure 4.2 shows animal months (months of use by an animal) for cattle and sheep for the Nez Perce National Forest according to available records. These records are thought to have some gaps, both in the period during which grazing occurred and in the numbers of animals. Numbers peaked at over 43,000 animal months in 1935, and declined as the young shrubs grew too tall for animals to reach and trees became established on old burns. The sheep market also declined after about 1940, and very little sheep grazing has occurred since then. The areas most heavily used included: Coolwater Ridge, Indian Hill, Green Mountain, Otterson Creek, Buck Lake Creek, Schwar Creek, Butte Creek, Simmons Creek, upper Meadow Creek, and the East Fork of Meadow Creek.

Cattle and a few horses were grazed in the Middle Fork Clearwater River, Clear Creek, Tahoe, Glover Ridge, Boyd Creek, Iron Mountain, Hamby Creek, Green Mountain, and Anderson Butte areas. Grazing was sustained at high levels from about 1935 through 1964; available records indicate 2,000 to 3,000 animal months per year on the Nez Perce National Forest during this time period. The areas of highest and most prolonged use have been the Clear Creek and Tahoe

areas. Grazing has declined as small operations have become unprofitable, transitory range has declined, and requirements for herd management to meet environmental standards have increased.

Figure 4.2: Livestock Grazing Levels After 1930 for the Nez Perce National Forest



CULTURAL AND HERITAGE RESOURCES

The Selway portion of the assessment area contains numerous locations where human activity has taken place, and has been subdivided into three zones in order to better understand the human factors of each zone. These zones are the Upper Selway, Middle Selway, and Lower Selway. The Upper Selway Zone extends from the Selway River headwaters down the Selway River to and including Moose Creek and its tributaries. The Middle Selway Zone comprises the area from Moose Creek downstream to the wilderness boundary at Race Creek. The Lower Selway Zone contains the roaded portion of the Selway subbasin, from Race Creek downstream to the confluence with the Lochsa River.

Within this large area, 99 cultural sites have been formally documented. This includes 45 prehistoric Native American sites, 38 historic Euro-American sites, and 16 multicomponent sites (sites containing both Native American and Euro-American materials). Overall, 73 of these sites are eligible for inclusion in the National Register of Historic Places (NRHP). Two sites, Fenn Ranger Station and Moose Creek Ranger Station, are listed on the NRHP. Twenty-two sites have been determined to not meet eligibility requirements for inclusion in the NRHP, and four sites remain unevaluated.

The Upper Selway Zone contains 22 documented cultural sites. Four sites are prehistoric and 14 are historic. Seventeen sites are eligible for the NRHP, and five are not. Prehistoric site types include campsites, rock art, a rock shelter, and travel routes. Historic sites include ranger stations, homesteads, trapper cabins, river crossings (trams), guard stations, a grave, and travel routes.

ROADS

The Middle Selway Zone contains 14 documented sites, the smallest number in any of the three Selway zones. Seven sites are prehistoric, three are historic, and four are multicomponent. Eleven of these sites are eligible for the NRHP, one is not NRHP eligible, and two sites in this zone remain unevaluated. Site types in this zone include prehistoric campsites, rock art, a rock shelter, and travel routes. Historically, forest fire lookouts, ranger stations, cabins, a grave, and travel routes were utilized here.

The Lower Selway Zone contains 63 documented sites, the largest quantity in any of the Selway zones. Of these, 34 are prehistoric, 21 are historic, and eight are multicomponent. Forty-five sites are eligible for the NRHP, sixteen are not eligible for the NRHP, and two remain unevaluated. Site types in this location consist of prehistoric campsites, food processing sites, lithic scatters, and travel routes. Historic sites here include ranger stations, cabins and other structures, forest fire lookouts, a fish hatchery, and travel routes.

TRANSPORTATION AND ACCESS

The transportation system in the Selway and Middle Fork Clearwater subbasin assessment area is composed primarily of road systems and trail systems. In addition, airstrips are a component that provide an important means of access into the middle reaches of the Selway drainage, with public airstrips at Moose Creek and Shearer, and private airstrips at Running Creek, North Star Ranch, Selway Lodge, and Seminole Ranch.

ROADS

HISTORICAL DEVELOPMENT

Road development began in the western portions of the assessment area, with the earliest development proceeding from the Kooskia area in the late nineteenth century. One of the earliest roads was the Elk City Wagon Road, which provided access from Kooskia to Elk City in the late 1800s. This route lies along portions of the western margins of the Selway and Middle Fork Clearwater subbasin assessment area. Road database records for the Nez Perce National Forest indicate that road construction in the Clear Creek drainage occurred as early as 1900. It is likely that road development in the Middle Fork Clearwater area had been initiated by that time as well.

Road development to provide access to fire lookouts occurred in the 1920s and 1930s throughout much of the Selway and Middle Fork Clearwater subbasins. Most of these roads still exist, and retain much of the character of their original configuration. They are typically managed at maintenance level II (maintained for high clearance vehicles). These routes include: Coolwater Ridge Road 317, Fog Mountain Road 319, Indian Hill Road 290, American River-Selway Road 443, South Nez Perce Trail Road 468 (also known as Magruder road), Elk Mountain Road 285, and Green Mountain Road 285A.

Subsequent to these initial developments, road development continued throughout the twentieth century, both in support of private development and in support of commercial timber harvest. Ecological reporting units (ERUs) that have experienced continued twentieth century road development include Middle Fork Clearwater, Clear Creek, and O'Hara and Goddard. While these ERUs have received road development throughout the twentieth century, they still contain inventoried roadless areas as well.

MAIN ROADS

Main roads within the Selway and Middle Fork Clearwater subbasins consist of a combination of state, county, and highway district roads, and Forest Service roads. State and county system roads are public roads, while Forest Service routes are not, although the agency now is considering options to designate portions of the system as public roads. Road locations can be

seen on Map 60, Main Roads Display. Descriptions of individual main roads are provided in Tables 4.5 and 4.6.

Table 4.5: Main Roads: State, County, and Highway District Routes

Road Name and Number	Road Surface	Road Description and Use
U. S. Highway 12	Double lane, paved.	An arterial that traverses through the assessment area from the city of Kooskia along the north bank of the Middle Fork Clearwater River upstream to the community of Lowell.
Clear Creek Road 515	Bituminous surface road upstream to the crossing of Clear Creek	Runs from the city of Kooskia up the Clear Creek drainage and eventually provides connection to the town of Clearwater. This route provides access to the Clear Creek fish hatchery as well as to residents in the western third of the Clear Creek drainage.
Leitch Creek Road 1842	Bituminous surface road	Provides access to the Tahoe Ridge area, the Nez Perce National Forest, and the community of Big Cedar. It is tributary to Clear Creek Road 515.
Big Cedar Road 1842	Primarily gravel surface	Provides access from Tahoe Ridge to the community of Big Cedar and on to the area of Potato Hill.
Clear Creek Cutoff Road	Lower reaches of this road are bituminous surface	Provides access from the Big Cedar Road 1842 to Clear Creek Road 515.
Harris Ridge Road	Gravel	Provides access to state and private lands on the north side of the Middle Fork Clearwater River.
Sutter Creek Road	Gravel	Provides access to state and private lands on the north side of the Middle Fork Clearwater river.
Selway River Road	Bituminous surface	The road is managed by the highway district from its junction with U. S. Highway 12 at Lowell upstream to the mouth of O'Hara Creek.

Table 4.6: Main Roads: Forest Service Routes

Road Name and Number	Road Surface	Road Description and Use
Selway River Road 223	Gravel	A Forest Service road from the end of the highway district section at the O'Hara bridge to its terminus at Race Track. This road is considered an arterial, as it provides primary access to the lower reaches of the Selway subbasin, including primary trailheads into the Selway-Bitterroot Wilderness.
Hamby Fork Road 651, and Swiftwater Road 470	Both gravel surface	Provide connection from Selway River Road 223 to road systems in the South Fork Clearwater and Clear Creek areas, respectively.

Road Name and Number	Road Surface	Road Description and Use
Tahoe Road 286	Gravel surface arterial	All three roads provide access along the north and east portions of the Clear Creek drainage as well as connection to the Swiftwater and Hamby systems.
Lodge Point Road 653	Gravel surface collector	
Hamby Loop Road 1129	Gravel surface collector	
Sears Creek Road 1106, and West Fork Clear Creek Road 650	Both gravel collectors	Provide access to trailheads and lands in the western portion of the Clear Creek drainage. These roads provide a motorized vehicle loop opportunity and have recently been stabilized to provide for all-weather use.
Smith Creek Road 101	Gravel surface arterial	Provides access to the Clearwater National Forest from U. S. Highway 12 from a point downstream from Syringa.
Boundary Ridge Road 464	Gravel surface collector	Generally follows the hydrologic divide between the South Fork Clearwater River and the Selway River. It provides connection to several collectors on either side of the divide.

SEMI-PRIMITIVE ROADS

In addition to the higher-volume travel routes in the Selway and Middle Fork Clearwater assessment area, there is a system of roads that provides important recreational opportunities. These roads were typically constructed by the Civilian Conservation Corps in the 1930s, and exist today in much the same condition as when they were originally constructed. Table 4.7 provides details on these roads.

Table 4.7: Semi-Primitive Forest Service Routes

Road Name and Number	Road Surface	Road Description and Use
Coolwater Ridge Road 317	Native material	Provides access to the high elevation area between the Lochsa and Selway Rivers. Parts of this route are alternately on the Clearwater National Forest and the Nez Perce National Forest.
Fog Mountain Road 319	Native material	Provides access to the high elevation areas around the upper reaches of Gedney Creek. It also provides trailhead access to the Selway-Bitterroot Wilderness.
Indian Hill Road 290	Native material	Provides access to Indian Hill Lookout, overlooking the middle reaches of the Selway Canyon and Meadow Creek.

Road Name and Number	Road Surface	Road Description and Use
South Nez Perce Trail Road 468 (also known as the Magruder Corridor Road and the Montana Road)	Native material, with some gravel the first 14 miles on the west side, and some gravel and bituminous surface in the deep Creek section on the Bitterroot National Forest.	Provides connection from Red River Ranger Station on the Nez Perce National Forest to the Darby Ranger Station on the Bitterroot National Forest, traversing 101 miles of backcountry along the way. Traveling this route provides a unique opportunity to travel between two large wildernesses, the Selway Bitterroot and the Frank Church River of No Return.
Elk Mountain Road 285, and Green Mountain Road 285A	Native material	Provide access to high elevation areas near the heads of Meadow Creek, Goat Creek and Running Creek. They also provide access for backcountry and wilderness trailheads.
Road 6223	Native material	Provides access along the upper reaches of the Selway River downstream from Magruder crossing. It is an important access for river recreation and river administration.
Road 224	Native material	Provides access to Hell's Half-Acre Lookout.

Magruder Corridor

Perhaps the most famous of the semi-primitive roads is South Nez Perce Trail Road 468, which passes through a narrow strip of land between two wilderness areas known as the Magruder Corridor. The Nez Perce people established a southern route to move to and from their hunting and gathering grounds in what is now Montana. In the 1930s, the Civilian Conservation Corps constructed the road that connects Elk City, Idaho to Darby, Montana, roughly paralleling parts of the Nez Perce's southern travel route. The Magruder Corridor was created in 1980 when the Central Idaho Wilderness Act was passed and land south of the road became what is now known as the Frank Church-River of No Return Wilderness. The road passes through a narrow non-wilderness corridor that divides the Selway-Bitterroot Wilderness and the Frank Church-River of No Return Wilderness. It is a rough, steep, and winding road, with no services for 117 miles, and usually is closed by snow from early October to July. Some of the area was prepared for timber sales prior to 1980, and 14 miles of the road were paved for that purpose.

WILDERNESS PORTALS

Several routes, while not in the Selway and Middle Fork Clearwater subbasin assessment area, provide important portal access to lands in the assessment area. Table 4.8 provides details.

Table 4.8: Forest Service Routes: Wilderness Portals

Road Name and Number	Road Surface	Road Description and Use
Elk Summit Road 360	Native material	Provides trailhead access to areas in East Fork Moose Creek area. It starts from U. S. Highway 12 near Powell Ranger Station on the Clearwater National Forest.
Road 429	Native material	Provides trailhead access into the area around the head of Bear Creek. It originates from U. S. Highway 93 in the Bitterroot Valley.

ROAD SYSTEM CHARACTERIZATION

Road Density

There are approximately 997 miles of road, either existing or decommissioned, in the Selway and Middle Fork Clearwater assessment area (Infrastructure Database, 2000). Of this figure, approximately 280 miles are located on lands other than National Forest system lands (primarily in the Middle Fork Clearwater and Clear Creek ecological reporting units), and 717 miles are on Nez Perce, Clearwater, and Bitterroot National Forest lands and are administered by the Forest Service. Distribution of these roads by ecological reporting unit (ERU) is shown in Table 4.9.

Table 4.9: Road Mileage and Density by Ecological Reporting Unit (ERU)

ERU	Total Miles	Road Density (miles per square mile)
Middle Fork Clearwater	304.36	2.61
Clear Creek	299.83	2.95
Lower Selway Canyon	37.45	1.23
Middle Selway Canyon	13.43	0.14
Upper Selway canyon	23.76	0.14
O'Hara and Goddard	185.3	1.84
Meadow Creek	65.18	0.27
Otter and Mink	0.03	0.0
Marten Creek	0	0.0
Ditch Creek	0	0.0
Running and Goat	10.61	0.09
Selway Headwaters	13.87	0.06
Deep Creek	22.59	0.40
Indian Creek	0.32	0.01
White Cap Creek	1.65	0.01
Pettibone and Bear	0.07	0.0
Moose Creek	0.05	0.0
Gedney and Three Links	8.48	0.09
North Selway Face	10.10	0.29

As can be seen in Table 4.9, the majority of roads occur in the western ERUs, including Middle Fork Clearwater, Clear Creek, and O'Hara and Goddard. There are additional roads present in most of the other ERUs as well.

Road Maintenance Levels

Roads throughout the Selway and Middle Fork Clearwater subbasins are maintained at various levels. The maintenance levels are described below, and Table 4.10 provides a summary of maintenance levels by ERU. The numbers in the table are from the Nez Perce National Forest Infrastructure Database (2000), and have been rounded for clarity.

Maintenance Level 0: Maintenance not applicable. Road has been decommissioned.

Maintenance Level I: Basic custodial care. Closed yearlong. Brush has grown in on many of these roads.

Maintenance Level II: Suitable for high clearance vehicles. Open to highway vehicles seasonally or generally requiring a high clearance vehicle to negotiate.

Maintenance Level III: Suitable for passenger vehicles. Usually gravel surface, single lane.

Maintenance Level V: High degree of user comfort. Generally have an asphalt surface.

Maintenance level information not available: Roads are generally privately owned and operated.

Table 4.10: Selway and Middle Fork Clearwater Subbasin Road Maintenance Levels in Miles by Ecological Reporting Unit

ERU	Maintenance Level					
	0	I	II	III	V	Information not available
Middle Fork Clearwater	< 5	22	0.6	13	24	238
Clear Creek	<10	105	35	68		88
Lower Selway Canyon		9	4	16	9	1
Middle Selway Canyon			10	3		
Upper Selway Canyon			18	6		
O'Hara and Goddard	31	81	23	50		
Meadow Creek		31	22	12		
Otter and Mink			.03			
Marten Creek						
Ditch Creek						
Running and Goat			11			
Selway Headwaters		0.5	9	4.5		
Deep Creek			16	6.70		
Indian Creek				0.3		
White Cap Creek				1.7		
Pettibone and Bear						0.07
Moose Creek						0.05
Gedney and Three Links			8.5			
North Selway Face			9.8	0.3		
TOTALS		248.5	166.93	181.5	33	326

Travel Management and Excess Roads

As can be seen in Table 4.10, above, much of the road system in the more developed ERUs receives maintenance level I, basic custodial care. At this maintenance level (corresponding to a closed travel management prescription) efforts are made to inspect drainage structures and to keep surface drainage functional. Efforts are not necessarily made to clear brush from roads or to keep roads passable to highway vehicles; consequently many of these roads are grown in with vegetation to varying degrees. Many of the roads in this category are dead ends. Preliminary transportation planning indicates a portion of these roads may be excess to the transportation system.

Modest levels of road decommissioning have occurred in the Middle Fork Clearwater River and Clear Creek ERUs, while a somewhat greater level of decommissioning has occurred in the O'Hara and Goddard ERU. All of this decommissioning has taken place within the last 10 years.

The maintenance level III roads reflect much of the core road system while the maintenance level II roads reflect much of the backcountry access.

The mileage and percentage of roads that have travel restrictions in each ERU are displayed in Table 4.11 (mileages have been rounded to provide for clarity). Road miles represented as restricted in the table have some level of vehicle or season of use restriction placed upon them. Roads represented as open have no restrictions on them. Because travel prescription information is not readily available for much of the area outside of the National Forests, the "open" descriptor is used as a default for such areas. Also displayed in table 4.11 is an indication of roads that could be considered excess to the needs of the transportation system. This information is relative

only to the roads on national forest lands. It was developed based upon tributary acreage for timber harvest. As such it can be considered a coarse screen only. Specific roads will need to be identified through roads analysis and project-specific NEPA analysis.

Table 4.11: Travel Management and Potential Excess Roads

ERU	Total Miles	Excess Miles	Miles Open	Miles Restricted	Percent Restricted
Middle Fork Clearwater	304	19	232	72	24
Clear Creek	300	86	172	128	43
Lower Selway Canyon	37	0.9	27	10	27
Middle Selway Canyon	13	0	3	11	80
Upper Selway Canyon	24	0	13	11	45
O'Hara and Goddard	185	52	57	92	61
Meadow Creek	65	5.3	19	46	70
Otter and Mink	0.03	0	0.03	0	0
Marten Creek	0	0	0	0	0
Ditch Creek	0	0	0	0	0
Running and Goat	11	0	11	0	0
Selway Headwaters	14	0.05	9	5	35
Deep Creek	23	0	15	7.4	33
Indian Creek	0.3	0	0.3	0	0
White Cap Creek	1.7	0	1.7	0	0
Pettibone and Bear	0.07	0	0	.07	100
Moose Creek	0.05	0	0.05	0	0
Gedney and Three Links	8.5	0	0.05	8.4	99
North Selway Face	10	0	0.2	9.8	98

Restriction levels (percent of road miles with some level of vehicle or season of use restriction placed upon them) tend to be higher in ERUs with greater amount of road, although in some of the lesser developed ERUs the percent restricted is variable due to the small amount of road present. O'Hara and Goddard ERU and Clear Creek ERU can be characterized as being heavily restricted.

The amounts of road that may be excess to the needs of the transportation system also tend to be higher in ERUs with greater amounts of existing roads. For ERUs that have received timber harvest in the past, potential reductions in road mileages of 10 to 30 percent may be appropriate.

TRAILS AND TRAILHEADS

TRAILS

Historical Development and Use

Native Americans established the first trails in the Selway and Middle Fork Clearwater subbasins, often following routes used by large animals. Prospectors, trappers, and railroad surveyors expanded the network of trails. The Forest Service constructed new trails to transport materials for installing telephone lines, building lookouts, and constructing bridges and administrative sites. Hunters, outfitters and firefighting also drove trail construction and maintenance. In the 1920s and 1930s, trails could be found on most major ridges and up most major drainages. Roads were built in the 1930s and 1940s, many to access timber for harvest, and this changed the pattern for trail construction and use. Roads came to connect segmented pieces of trail.

Trail construction and maintenance flourished in the 1930s when large forces of Civilian Conservation Corps workers were employed, and again in the 1960s through the work of the Job

Corps. Trail conditions and numbers of maintained trails began to decline in the 1970s. Prior to the decline in volume of timber harvest, fire and timber monies supported trail construction.

The traditional practical and functional use of the extensive existing trail system is evolving into recreational use. There are three national recreation trails in the Selway and Middle Fork Clearwater subbasins: Anderson Butte, East Boyd-Glover-Round Top, and Meadow Creek Trails. The historic Nez Perce Trail passes through the area. The trail system continues to be reduced from its historical mileage due to lack of use and reduced maintenance funding. The Forest Service no longer supports large work crews and firefighting forces. The public today prefers shorter scenic loop trips that can be accomplished in a weekend to four days.

Off-highway vehicle (OHV) use of trails and roads in the Selway and Middle Fork Clearwater subbasins is estimated to have doubled in the last ten years. Pressure is increasing to make more trails available for bicycles, 4-wheelers, snow machines, and other motorized use. Hundreds of miles of existing roads in the assessment area are available for OHV use, and fifty miles of trail have been constructed for OHV use over the last ten years. OHV users do not always want to be on roads; they sometimes seek a trail experience.

Trends indicate that use of trails deep within the backcountry will decrease. More recreationists indicate a preference for quick and easy forest access and trails where OHV use is allowed. They tend to use trails within five to ten miles of trailheads. Serious hikers and some backcountry stock users prefer to take the longer, more challenging trips on secondary and way trails.

Many visitors choose not to use trails because they have other options for enjoying their forests. The scenic highways and roads within the Selway and Middle Fork Clearwater subbasins offer exceptional opportunities for viewing wildlife and enjoying spectacular vistas from the comfort of family automobiles.

Funding and Maintenance

A total of 1,157.5 miles of trail are currently on district inventories across the Selway and Middle Fork Clearwater subbasins (see Map 61). Those numbers do not necessarily reflect the miles of trail that are used or maintained. All forests are in the third year of a Meaningful Measures/Infra process to inventory current mileage and conditions of all system trails. By 2003-4, trail management decisions will be based on an accurate assessment of existing trails.

Currently, trails specialists estimate that about 15 percent of all mainline and secondary trails get attention each year as they attempt to balance a vast trail system against meager financial resources. Budgets allow for minimum trail maintenance resources that are not sufficient to maintain trails to the specifications of forest plans. Most trails do not get attention beyond level 1 requirements. System trails on the Nez Perce National Forest, inside and outside the wilderness, are to be maintained to the standards or levels explained below, according to the Forest Plan.

Maintenance Levels for Wilderness and Non-Wilderness Trails on the Nez Perce National Forest

Level 1 - (Opening): Minimal amount of clearing, route marking, structure repair and drainage to provide for usability, safety, and resource protection.

Level 2 - (Normal): Intermediate level of clearing, route marking, structure repair and drainage. Includes moderate tread repair, brushing and rehabilitation of drainage structure.

Level 3 - (Heavy Maintenance): Significant amounts of work described in Levels 1 and 2. Maintenance cost allowed up to 30 percent of the average cost of new construction.

Table 4.12 describes trail maintenance levels for wilderness and non-wilderness trails on the Nez Perce National Forest.

Table 4.12: Trail Maintenance Levels for Wilderness and Non-Wilderness Trails on the Nez Perce National Forest

Trail Class	Minimum Service Level Standard	Full Service Level Standard
Mainline	Level 1 annually Level 2 every 3 years	Level 2 annually Level 3 every 5 years
Secondary	Level 1 every 2 years Level 2 every 5 years	Level 1 annually Level 2 every 3 years Level 3 every 10 years
Way	Level 1 every 5 years	Level 1 every 3 years Level 2 every 6 years
Snow	Level 1 annually Level 2 every 5 years	Level 1 annually Level 2 every 3 years

Maintenance Priority and Frequency for Trails in the Selway-Bitterroot Wilderness

Table 4.13 displays trail maintenance priorities and frequencies for the Selway-Bitterroot Wilderness.

Table 4.13: System Trail Maintenance Priority And Frequency for the Selway-Bitterroot Wilderness

Management Area	Complete Log Clearing	Partial Log Clearing	Drainage Work	Woody Vegetation Removal	Tread Work
Opportunity Class 1	N/A	N/A	N/A	N/A	N/A
Opportunity Class 2	None	Priority 3, on a 3 to 5 year cycle	Priority 1, on a 3 to 5 year cycle	Priority 4, on a 5 year cycle	Priority 2, as needed
Opportunity Class 3	Priority 2, annually	Priority 1	Priority 1, annually or as needed	Priority 3, on a 3 to 5 year cycle	Priority 2, annually
Opportunity Class 4	Priority 2, annually or more as necessary	Priority 1, annually or more as necessary	Priority 1, annually or more as necessary	Priority 3, annually or more as necessary	Priority 2, annually or more as necessary

TRAILHEADS

At twenty-two trailhead sites in the assessment area, signs and bulletin boards provide visitor information and an opportunity for visitor registration, and restrooms and horse facilities are available. Most signs were constructed and placed starting in the 1930s and later improved. Trailheads are maintained every two years and when repair is necessary, and signs are usually removed in the winter, reconditioned, and replaced.

Those trailheads in more remote areas are difficult to maintain because of snow loads and vandalism. Many are below standards and bulletin board information is not up-to-date. Signs encourage visitors to register, but many do not, and Forest Service personnel are seldom available to systematically collect registration cards at distant trailheads.

At popular trailheads, especially those used by hunters and outfitters, several dispersed campsites exist. Tree stumps, large impacted areas, and fire rings exist, and often there is

evidence of constructed corrals or other improvements. Trash, building materials, water lines, and other cache items remain in some abandoned outfitter camps and other dispersed sites near roads. During hunting season, there are reports of crowded parking situations at some trailheads. At other times during the year, parking is not a problem. Work loads do not allow Forest Service personnel to systematically monitor, clean or restore all trailhead sites.

A research project on the Bitterroot National Forest in 1993 queried visitors as they exited at trailheads. The information gathered suggests that messages presented on trailhead bulletin boards might not be an effective tool to educate and inform visitors. Visitors usually do not have an opportunity to speak with agency personnel before departure on trails because no formal registration or permit system is in place. More information is needed to determine how best to communicate critical information to recreationists.

AIRFIELDS

In 1931, the Forest Service built the first airstrip at Moose Creek, and in 1933 and 1934 built another on land purchased from Phil Shearer. Airstrips were also constructed at Moose Ranches, Trout Creek, North Star, Running Creek, Selway Lodge and Seminole Ranch, all private inholdings. Except for Moose Ranches and Trout Creek, all are in use today. Private and public use of aircraft predated the primitive area classification in 1936. Therefore, the Wilderness Act of 1964 made exceptions for backcountry airstrips and allowed their continued use. The Forest Service does not regulate private airfields and air traffic on national forest and wilderness lands, but basic FAA (Federal Aviation Administration) regulations apply.

The Wilderness Act provides for administrative (general management, fire, emergencies, other agencies), commercial (outfitters), and private use of public airstrips within wilderness, subject to restrictions and regulations. According to the 1992 *Selway-Bitterroot Wilderness General Management Direction*, federal airfields in the wilderness portion of the assessment area are to function as internal portals for users pursuing wilderness-dependent activities. The *General Management Direction* further states the following in relation to wilderness airfield management:

Administrative access to wilderness will be managed by the minimum tool principle. Pack stock and foot travel will be preferred. Private use will be managed to discourage short-term visits and proficiency landings. No specific standard will be assigned for length of stay; rather, when total users exceed acceptable levels, management methods will be imposed to reduce use that is not wilderness dependent. Existing proportions of use by commercial, private, and administrative landings will be used as a standard. These proportions will be based on four years of data from each airfield. Levels of use will be monitored to avoid further erosion of wilderness values. The impact of flights on other users will be stressed rather than the number. (p. 0-2)

Data is available for Moose Creek landings, but monitoring at Shearer has been discontinued due to lack of funds. Maintenance facilities may be provided at federal fields to meet safety standards but with the least possible departure from natural conditions. Airfield conditions will be monitored by photo points and transects and will not be permitted to worsen, but may be improved from the current level (*Selway-Bitterroot Wilderness General Management Direction*, 1992).

Records available since 1975 show that airstrip use at Moose Creek has decreased. Weather conditions, the presence of smoke, and fire suppression activity significantly affect airstrip activity erratically influence flight data. This is reflected in the records for landings at Moose Creek since 1975. There has been some inconsistency in definition of administrative and commercial flights and in numbers of days per season that flights were recorded during the period of record; and data for 1996 and 1997 are not included. Trends can be determined from the available flight monitoring data, however. Until 1981, total flights averaged about 750 per field season (April through October). From 1981 through 1988, total flights averaged about 980 per field season.

AIRFIELDS

Since 1989, flights have averaged about 564 per field season. Private aircraft use now accounts for the highest percentage of use (increased from as low as 36 percent to about 80 percent of total use), and is returning to use levels of the 1980s. Outfitter use decreased sharply after 1991 (from as high as 37 percent of total use to 11 percent), and administrative use declined most significantly (from a high of 24 percent to one percent of the total landings). The balance of use consists of other administrative uses, such as fire suppression and use by other agencies.

Available landing data indicate that although total numbers of flights at Moose Creek have decreased since 1975, average private use is increasing while administrative use decreases. Airstrip use by outfitters fluctuates as the number of outfitters who operate in the area changes.

No data are available for use at Shearer Airfield. General condition of the airstrip, overflights observed at Moose Creek, and observations by visitors at Shearer indicate that use is increasing and conditions deteriorating.

The Forest Service Region 1 Air Center in Missoula sends inspectors to Moose Creek and Shearer annually to make observations and recommendations for maintenance and use.

BRIDGES

Due to the topography of much of the assessment area, consisting of narrow canyons and steep slopes, bridges are an important component of the trail and road systems in the Selway and Middle Fork Clearwater subbasins. Bridges are used on all major transportation systems, including state, county, and Forest Service systems. Their maintenance is an important component of the management of these systems. Without these bridges much of the existing transportation system would be unusable, and use patterns would be dramatically altered. Table 4.14 provides an overview of the bridges spanning the main rivers. Additional bridges occur on state, county, and Forest Service systems crossing smaller waterways.

Table 4.14: Bridges Spanning the Major Waterways of the Selway and Middle Fork Clearwater Subbasins

System	Location	River	Bridge Type
State Highway	Kooskia, Highway 13	Middle Fork Clearwater	Steel Truss
County Road	Kooskia	Middle Fork Clearwater	Steel Truss
Private Road	Syringa	Middle Fork Clearwater	Suspension
Private Road	Various from Kooskia to Syringa	Middle Fork Clearwater	Tramways
County Road	Lochsa mouth, Road 223	Lochsa	Steel Girder
Forest Service Road	Swiftwater Creek, Road 470	Selway	Steel Truss
Forest Service Road	O'Hara Creek, Road 651	Selway	Steel Girder
Forest Service Road	Selway Falls, Road 443	Selway	Steel Truss
Forest Service Road	Magruder Crossing, Road 468	Selway	Steel Girder
Forest Service Trail	Moose Creek, Trail 437	Selway	Suspension
Forest Service Trail	Selway Lodge, Trail 4	Selway	Suspension

System	Location	River	Bridge Type
Forest Service Trail	Running Creek, Trail 4	Selway	Suspension
Forest Service Trail	Near Fire Creek, Trail 3	Selway	Steel Girder
Forest Service Trail	Magruder, Trail 26	Selway	Steel Girder
Forest Service Trail	Wilkerson Creek	Selway	Wood Stringer

Maintenance of trail bridges in the wilderness environment can present difficult management considerations. Often, due to the physical size of bridge materials, coupled with the remote location of these structures, motorized or mechanized support is required to complete needed repairs. This difficult management environment will continue to exist in the future and will continue to need to be addressed on a case-by-case basis. Designs are being evaluated, however, for bridges made from sections small enough to be packed in to a bridge construction site by horses or mules. Current designs allow for spans up to 36 feet in length to be constructed using packable sections. This technology may provide alternatives to using mechanized bridge construction and repair support in at least some locations.

SOCIAL, ECONOMIC, AND DEMOGRAPHIC CONDITIONS

STAKEHOLDERS IN THE SUBBASINS

Stakeholders in the Selway and Middle Fork Clearwater subbasins are those who have a share or interest in what happens in the subbasins. Stakeholders are the people who live in or near the subbasins (or who live elsewhere) and use the subbasins for various purposes --- commercial, recreational, and spiritual.

People who live within the area are few. The small, unincorporated communities of Lowell and Syringa are the only concentrations of human population (30 to 40 persons each) within the boundaries of the Selway and Middle Fork Clearwater subbasin assessment area. However, the residents and towns situated within 5 to 20 miles from the subbasins hold major historic, economic, spiritual, and recreational connections with those lands and rivers. Grangeville, Kooskia, and Elk City (Idaho County) are portals in Idaho. Darby and Hamilton (Ravalli County) are portals to the assessment area in Montana.

PURPOSE AND OBJECTIVES OF THE SOCIAL ASSESSMENT

PURPOSE

The objective of this social assessment is to learn how and why people's values, beliefs, needs, wants, sense of place, lifestyles, and use, in terms of national forest lands, are changing. It provides insight into public perceptions of the dynamics of national forest management. Primary social assessment goals are as follows:

- Recognize stakeholders' needs and demonstrate to the public that the Forest Service is sensitive to opinions and perceptions.
- Highlight places of special stakeholder interest.
- Characterize the overall social setting.
- Identify trends.
- Provide information to enable the Forest Service to understand and address issues in order to improve credibility and trust.

PURPOSE AND OBJECTIVES OF THE SOCIAL ASSESSMENT

- Investigate the ways people prefer to be involved.
- Ascertain ties to the land, emotions evoked and values that led to perceptions.
- Provide information that will be useful across the board for specialists and managers.

Traditionally, the Forest Service has provided strong technical solutions to natural resource problems. To develop an improved conceptual approach to manage change in park and wilderness areas, the University of Washington College of Forest Resources, the National Park Service and the USDA Forest Service convened an Ecosystem Management Workshop in 1987. A perception that repeatedly surfaced at the workshop was that participants with biological expertise tended to under-appreciate the role that people play in defining both the problems and solutions for park and wilderness issues. People are both managers and components of park and wilderness ecosystems. The biocentric orientation dissipated as the workshop progressed (Johnson and Agee, 1988.)

OBJECTIVES

The social assessments can better equip Forest Service managers to address changing social, economic and biophysical conditions. A social assessment can help managers address issues and promote collaboration with the public as the Forest Service prepares to revise the forest plan.

The social assessment document can gather information and describe:

- The social and economic environment
- Public wants, needs, desires, and values
- Public perceptions about Forest Service land management

The social assessment results can help managers understand:

- How social conditions are linked to, affect, and are affected by natural resource conditions
- What social changes and effects are likely to result from resource management actions and changing resource conditions

The social assessment can provide:

- Criteria to evaluate risks and tradeoffs
- Criteria for decision-making, and
- A method to incorporate people's needs, wants and desires into ecosystem management.

METHODOLOGY

This social assessment is based on an ethnographic interview methodology. Ethnographic interview methods were used to collect qualitative data using an interview protocol that was administered to a targeted sample of individuals within, and who visit the study area of the Selway and Middle Fork Clearwater subbasins. This approach is built around the idea that the way of life of a people and how they evaluate their world are facts to be discovered, not assumed. It is significant that an ethnographic study is used to develop a description and analysis of events from the point of view of the persons within a social setting being studied.

This methodology should not be confused with a survey, whose purpose is to produce statistical information about attitudes and opinions or demographics. Ethnography is about how and why people invest meaning in the ideas they have. An important difference between survey and ethnographic methods is that a survey provides the categories of response for the subjects and an ethnographic interview asks the subjects for the categories and their meanings. Qualitative data, not quantitative data were collected. Neither method is inherently more scientific or preferable. Ethnographic methods are a valid and useful approach (Bernard, 1988).

APPROACH FOR DATA COLLECTION

“There are more avenues to reach people than ever before, but there’s no substitute for face-to-face communication.” --- Andrew Gilman, Com-Core Consulting Group, Washington, D.C.

Opinion leaders (persons knowledgeable about their community and natural resource issues within the assessment area) were selected by mailing a question form to all persons and groups on the Nez Perce, Bitterroot, and Clearwater National Forest mailing lists. Approximately 80 people responded, indicating they would participate in a public meeting, by phone, or by talking to someone face-to-face. That list of 80 people, categorized according to interest groups, was presented to the Selway assessment core team, and each core team member selected 30 names. Those selections were tallied and a list of the most frequently selected 50 people was established to contact for interviews. When three or more people from the original list suggested other contacts, appointments were made for discussions with those people, as well. Usually, the discussions lasted between 45 minutes to 2 hours. A total of 60 people were interviewed by one Forest Service representative from February through April of 1999 (see Appendix N for a table of names, interest groups, and geographic areas). The following questions were used to open the discussions:

- With what areas of the Selway and Middle Fork Clearwater subbasins are you familiar?
- What activities do you do there?
- Where is the place you most like to go? Why is it a special place?
- What have you seen change (on the ground or in management)?
- What would you like to see changed?
- How would you manage the area?

Following are two summarizations of how people relate to the land within the Selway and Middle Fork Clearwater subbasins. First, communities of place: the history, socioeconomic, and cultural factors of the communities of Kooskia, Grangeville, Elk City, Lowell, Syringa, Hamilton, and Darby.

Next, interest groups: the discussions with opinion leaders from a variety of interest groups. This section reflects the relationships that members of certain interest groups have with the land in the study area, their concerns, and their perceptions of Forest Service management. A more detailed summary of responses from various interest groups is found in Appendix N.

COMMUNITIES OF PLACE

IDAHO AND RAVALLI COUNTIES

Idaho County, Idaho and Ravalli County, Montana have experienced dramatic social and economic changes since settlement in the late 1800s. Those communities most directly tied to the Selway and Middle Fork Clearwater subbasins, which include Kooskia, Grangeville, and Elk City in Idaho and Darby, Hamilton and Victor in the Bitterroot Valley of Montana, share a common history and evolution in response to changes in land use and management. All emerged as the westward movement of men and women flooded the area in search of gold. Populations waxed and waned with exhausted supplies then new discoveries of precious minerals. Lumber was first cut to support mining operations. By the 1900s, railroads carried trading goods and supplies, lumber, livestock and flour to and from these communities whose success became tied to agriculture. Relatively few hardy people populated a vast land base and most shared uncomplicated common values that were tied to resource extraction. It was a new and difficult concept for the native Nez Perce people who occupied the basin when the influx of settlers arrived.

FOREST SERVICE ROLE

The U.S. Forest Service came to own the largest percentage of the land and played a dominant role in the harvest and growth of timber. The post WWII housing boom encouraged a dramatic increase in logging. Timber harvest in the national forests was right up to the allowable cut figure that jumped from 12.5 million board feet in 1957 to 63 million bf in 1966 on the Bitterroot National Forest. The Forest Service was guided primarily by the principle of sustainable yield; clearcut, terrace and plant. Six miles of road per square mile were built in order to get the cut out. Jobs related to timber were abundant and usually lucrative.

Interest groups were basic and few. The lumberjack heritage remains a part of each community. Small towns offered a sense of place for ranchers and farmers tied to land. Outfitters and guides catered to tourists who sought to hunt and fish in remote lands that teemed with elk and trout. The Forest Service was a major player in the social history of the Selway and Middle Fork Clearwater subbasins and also greatly influenced economic health. Few laws governed the use of natural resources.

NATURAL RESOURCES AND VALUES

Those who made a living from natural resources in the twentieth century found those resources to be generous, but not boundless, and their exploitation had consequences they hadn't anticipated. Large segments of the public began to recognize the rate of logging and some Forest Service practices threatened forest esthetics, wildlife, clear water, and other values. National attention was drawn to large acreages of underdeveloped land and clean, clear, free-flowing streams were viewed as national assets. People who lived outside the area began to exert influence over "their public lands". Local conservation-minded citizens took a stand. Idaho's Senator Frank Church led congressional hearings that focused on Forest Service management. The Forest Service responded and promised to reduce clearcuts and mileage for new roads and hired landscape architects to design cutting units with less visual impacts. The Forest Service expanded its management to include more than timber sales and acknowledged that public involvement was critical in its decision-making. Well-organized conservation groups pressured congress and local entities, while timber industry groups formed and campaigned to defend cutting.

ECONOMICS

Change was inevitable. The wealth of once-profitable mines "dried up"; land use focus withdrew from timber harvest; population increase and immigration from populated areas in the east and on the coasts caused the vast land base to shrink; development grew along the rivers and in small communities; demand for recreation in a unique setting flourished. Those few, basic values and lifestyles associated with extraction of resources --- hard work, honed specialized skills, rugged individualism, independence and a strong sense of freedom --- characterized the citizens of the Selway and Middle Fork Clearwater subbasins before the mid-1900s.

Today, values, lifestyles, and beliefs are much more complicated. The natural resources of the subbasins are also valued for breathtaking scenery, pristine rivers, perpetuation of natural ecological processes, wilderness experiences and other diverse recreational experiences. There are also emerging economic lifestyles and those who seek to prosper from real estate, tourism, businesses, service industries, manufacturing, and trade. Since the mid 1900s, many laws have been in effect that govern use of the subbasin area. Conflicts and questions abound when the realm of values, beliefs and lifestyles are so diverse. The challenge to Forest Service management increases proportionally to a wider array of interest groups. See Appendix O for demographic and economic information.

INTEREST GROUPS

Stakeholders in the Selway and Middle Fork Clearwater subbasins have varied interests and attachments to the rugged, forested lands. Evidence of the departure from historically few

numbers of interest groups is the wide diversity of the nineteen groups identified for this assessment. These groups are:

- Interest in timber harvest
- Business owners
- Elected officials
- Local residents
- Interest in motorized recreation
- Interest in non-motorized recreation and backcountry hiking
- Riders and pack stock users
- Interest in water recreation
- Interest in hunting, fishing and camping
- Members of environmental groups
- Historians and long-time residents
- Outfitters and guides
- Interest in wilderness attributes
- Interest in preserving cultural and archaeological sites
- Pilots
- Citizens with private inholdings
- Former US Forest Service administrators and staff
- Selway Assessment core team members
- Nez Perce tribal members

Two to five people from each group (many interviewees represent more than one interest group) were interviewed and asked to discuss the following items:

- Values, beliefs, attachments, and lifestyles
- Perceptions of Forest Service management
- Concerns about the present and future

A sample of more specific comments and concerns of those individuals interviewed from each of the 19 groups is included in Appendix N. Comments are generally paraphrased and quoted where indicated. The opinions and comments of those opinion leaders interviewed do not necessarily represent the entire population of those non-interviewed citizens who might also fit into the category. A brief summary of all responses from all categories is shown below.

VALUES, BELIEFS AND LIFESTYLES

The opinion leaders expressed a wide range of ideas on values, beliefs, and lifestyles, both within and between user group categories. The statements below summarize some of the ideas expressed by opinion leaders during interviews (see Appendix N for more details).

- The value of the landscape and its resources is important.
- The traditional attributes of self-reliance and independence are valued.
- Excessive government regulation is sometimes considered a threat to traditional lifestyles.
- An outdoor lifestyle related to work and to recreation is important.
- Rural lifestyles provide security, freedom from the stress associated with metropolitan lifestyles, and community support.

- Special interest groups have organized in response to specific issues. Conflict sometimes causes polarization among groups. Long-time residents act through their connections with one another and newcomers tend to act through formal organizations.

PERCEPTIONS OF USFS MANAGEMENT

The 60 opinion leaders interviewed generated the following management issues. They are reported in order of frequency mentioned. The comments are usually paraphrased, sometimes quoted as indicated, and other narrative interpretations are added. See Appendix N for specific responses by various user group categories.

The Forest Service has been an integral part of the social and economic structure of Idaho and Ravalli counties since the early 1900s. It has profoundly affected the economic health of and manages the major portion of land in the Selway and Middle Fork Clearwater subbasins. There are strong sentiments about the agency among residents who hold diverse values. Opinion leaders discussed: (1) The effectiveness of the agency as a manager; (2) the competency of leadership; (3) the involvement of the Forest Service in communities; and (4) public trust.

Effectiveness as Forest Managers

Many expressed frustration with Forest Service planning and studies and the observation that many agency employees spend a lot of time in meetings, in front of computers, and driving green rigs up and down the highway rather than working on the ground. Some have been part of citizen task force groups and feel that much time was spent in planning and little in implementation. They feel their efforts and the tax payers' money is wasted. There is a general lack of understanding about the work requirements of the Forest Service and the legal restraints that the agency works within.

These perceptions suggest the public needs more information and involvement in Forest Service activities to understand how groups and individuals have often "tied the hands" of local managers.

Consistency of management policy is considered a problem, because the public does not know what to expect when administrations change. Experience has taught the public that every time a district ranger position changes, policy changes as well. Funds are wasted because of lack of institutional memory, and much work has to be started over and new studies done. Several felt that personnel, especially leaders, were promoted and moved on before they were ready. Such a rapid climb up the career ladder did not give agency employees enough time to get to know the ground or the public.

Competency of Forest Service Leadership

Most opinion leaders feel that leadership competency is directly tied to knowledge of the land base and of the public it serves. As described above, rotating personnel makes knowledge of the land more difficult. There is some concern that university degrees are not a substitute for "common sense" and that leaders do not tap the knowledge and resources of long-time residents who "know the land." Several former FS employees think the qualification standards for leadership positions are lower than in the past. They see the agency as "going downhill."

Those individuals were associated with the agency from 5 to 20 years ago and are not always familiar with the complex issues and challenges that leadership currently faces.

A former administrator recognized that the "mood of the Forest Service is changing, that rangers are expected to be figureheads, to attend meetings where they meet the public, and to be active in the political community." He feels that is just as important a role as being on the ground; but ideally, leaders could do both.

Forest Service Involvement in Communities

Those who have lived in the area for most of their lives remember how the Forest Service personnel used to be more obvious members of the community; they stopped by for a cup of coffee or attended social events. There is sentiment that Forest Service people keep to themselves, in their own cliques, separated from their neighbors without investing in “social capital.” They understand that personnel who do not remain in one position for more than two to three years cannot develop strong community ties. While many individual agency employees are involved in community activities, they do not seem to get personally and socially involved with other citizens. When the district or forest supervisor’s office gets involved in community activities it seems impersonal or “political.”

These perceptions, which may be different than actual involvement, warrant further consideration by the agency. There are contradictions, however, because local people expect and depend upon the Forest Service to respond to fire and to emergency situations.

Public Trust

While some individuals within the Forest Service are perceived to be trustworthy, mistrust increases in proportion to levels of agency management. It is understood that when new personnel are named to management positions, policy will probably be revised. “One ranger tells us one thing; the next one comes along and changes it.” Another comment is that “often the Forest Service makes a deal to satisfy everyone, and then changes it later on.” A very common complaint is: the Forest Service asks for public comment, then ignores it.

When the agency attempts to compromise the interests of diverse groups, those whose agenda is not satisfactorily fulfilled interpret it as inequity or disregard.

CONCERNS ABOUT THE PRESENT AND THE FUTURE

The opinion leaders interviewed generated the following resource management issues. The issues are compiled in order of frequency mentioned and include: (1) wilderness, (2) access, (3) biodiversity, and (4) special uses. The comments are usually paraphrased, sometimes quoted as indicated, and other narrative interpretations are added. See Appendix N for specific responses by various user group categories.

Wilderness

Designated wilderness is the subject most often mentioned among interviewees. The Selway-Bitterroot (SBW) and Frank Church-River of No Return (FCRONRW) Wilderness areas are considered by some interviewees to be both “unique” and “special for being so rugged, remote and vast,” and also a “treasure unlike any other area.” Several interviewees spoke very emotionally as they described their attachment to “special places.” Various opinion leaders were directly involved with the composition and implementation of the Wilderness Act of 1964, and they are concerned about departures from the original intent of that legislation. Others were part of a citizens’ task group (1987-1992) that assisted agency management in developing standards and limits of acceptable change for the Selway-Bitterroot Wilderness. Many voice strong feelings about reinstating that group; saying that it had vision and that it was the cohesive force that gave direction to wilderness management. “Implementation of the LAC [limits of acceptable change] process is important to ensure that degradation of wilderness does not occur; that Wilderness remains to provide for ‘a primitive and unconfined type of recreation that contains ecological, geological or other features of scientific, educational, scenic or historical value’ [as stated in the Wilderness Act of 1964].” Several fear that the wilderness is being compromised and that the Wilderness Act is being interpreted to fit political needs.

Some consider fragmentation in management (two forests and six districts on the SBW) a disadvantage. Most feel that wilderness needs strong leadership and an identity separate from

INTEREST GROUPS

recreation. They support appointing a SBW and FCRONRW coordinator as well as a director at the national level as a solution to “saving wilderness.”

Historical resources are embroiled in the biocentric and anthropocentric discussions of wilderness philosophy. While some opinion leaders advocate obliteration of all human-built structures in the wilderness (one stating that “the ultimate historical site IS wilderness”), others believe that human beings and their history there are an integral part of the land. “We cannot take the human factor out of wilderness. It is our heritage, and we don’t recognize that.”

Aviation use within the wilderness is a contradiction for some who hike or ride into the backcountry. There is often misunderstanding about how airplanes are allowed in an area where bicycles and other mechanical means of transport are not permitted. The aviation community adamantly defends their use of Moose Creek and Shearer airstrips, opposes airfield restrictions, and supports maintaining a camping area near Moose Creek. Many pilots believe that flying allows for their personal “wilderness experience,” and that diverse airstrip conditions offered by the several backcountry fields provide levels of wilderness expectations much as opportunity classes do for hikers or horse riders. Some wilderness visitors feel that aircraft noise is excessive and intrusive, especially at Moose Creek.

Access

The use of roads and trails in the assessment area is an important concern of many opinion leaders. While some think they are being “shut out” of public lands, just as many think that public lands are too accessible and that a permit system should be in place. The area is extremely important to stakeholders for hunting, fishing, and other recreation, but they also value the natural beauty, scenic quality, and rural lifestyle. Stakeholders seem to be more concerned about the health of the land than in the past, and are willing to sacrifice some freedom of access. Most agree that trail maintenance needs improvement, and note that the mileage of usable system trails has significantly decreased. Traditional use that took pack strings and long-distance hikers into the heart of the backcountry is diminishing. A frequent hiker has noticed that about 75 percent of the people he met on the trails were day hikers and that most trail and campsite use is on the fringes of the backcountry, within the first five miles of the trail system. As off-highway vehicle (OHV) use has been observed to be increasing at a rapid rate, opinion leaders express concern about how motorized use will be managed. OHV interest groups feel they are sometimes discriminated against, and believe that more miles of trail should be available for their use. Although there are sometimes conflicts between some user groups, most agree that trails should remain open for everyone. For most interest groups other than hikers, the availability of trails is more important than the issue of who is allowed to use them. Some recreationists feel that impacts by stock use are the most significant and lasting. Horse riders feel that if more trails were maintained and available for use, trail and campsite use could be dispersed and result in less resource damage.

Although 72 percent of the assessment area is wilderness or roadless, the forest road system is an important issue for many interviewees. These interviews took place before the “roadless policy” was announced in 2000; therefore, concerns surrounding that decision are not included. How and where road obliteration takes place is a concern. Most interviewees do not understand exactly how road obliteration decisions are made and how road-related erosion problems are addressed. There are considerable opportunities to educate and inform the public about roads issues.

Biodiversity

Nearly all stakeholders are seriously concerned about the spread of noxious weeds and feel the situation is out of control. People see weeds along the wild and scenic river corridors, along almost every trail, deep within the wilderness, and in meadows where wildlife formerly grazed on native grasses and forbs. The consensus is that aggressive action should be taken, but that the

Forest Service hesitates to respond. It is difficult to understand the complex biological issues associated with weed treatment on public lands.

Protection of the biodiversity of small populations of rare species is very important. One person suggests that “zoning” lands for their best uses would be a good approach to protection of diversity. The subbasins’ unique stronghold for native fish species is highly valued. Most interviewees agree that introduced non-native species should be dealt with, but do not consider eliminating recreational fishing opportunities in high mountain lakes and streams an option. They see a solution in stocking with native species. Some regard indicators such as long-toed salamanders and spotted frogs as insignificant “slimy little reptiles.” People are concerned about protecting and recovering salmon and other species, but usually do not consider how that applies to maintaining genetic integrity.

The reintroduction of grizzly bears and wolves presents other concerns. Hunters consider grizzlies and wolves a threat to elk and deer populations that they feel already suffer from the pressures of other predators and habitat loss. Many feel that the grizzly bear is dangerous to recreationists and threatens the safety of local residents and domestic animals. Others explain that the grizzly bear is a natural part of the area ecosystem and feel that “we’ll just have to get used to them and start changing our ways now.”

Fire remains a controversial issue. Most stakeholders understand that fire is necessary for forest health and to minimize threats of overly severe fire events, but object to fire when it is in close proximity to their property, when it “blackens the landscape and ruins the scenery,” and when it “pollutes” the air.

Special Uses

Outfitters and Guides: The Idaho Outfitters and Guides Association regulations are considered to be demanding and more restrictive than those of other states, according to outfitters who operate in the assessment area. While some outfitters feel that they are discriminated against and treated differently from the public, several opinion leaders consider outfitters to be enjoying special privileges and to be very possessive of their areas. Some individuals say that outfitter activity drives agency management decisions.

Timber: Timber harvest has traditionally been the fabric of the local economy. Most opinion leaders’ lives have been either directly or indirectly influenced by logging. Those who discussed timber during the interviews all agree that there are areas where logging could and should be done, but that it should be done with discretion. Within that same group, there was no mention during the interviews of the ecological implications of timber harvest except for its role in creating habitat for the declining elk population. Stakeholders are especially sensitive to limiting visual disturbance, particularly in popular visitor areas along highways and river corridors.

Private Inholdings: Of the several homesteads established in the assessment area in the mid-1900s, four private inholdings remain within wilderness boundaries. There is much speculation about subdivision and development of those lands. Wilderness advocates fear that owners not under the jurisdiction of scenic easements will take advantage of commercial development on those unique “last great places.” Today’s landowners visit their wilderness homes a few weeks or months out of the year, and generally have strong feelings about the rights they enjoy as private property owners.

Individuals With Alternative Viewpoints: Some stakeholders who have hiked, ridden, or driven through the forests over the years explain how they are meeting up with some unusual “folks in the woods these days.” In the past it was not a concern, but today, they feel uncomfortable about, and sometimes threatened by, some individuals they encounter. One hiker met three different “eccentric people” who told him they wanted to give up their life-style in civilization and that they had come to “live in the woods.”

SOCIO-ECONOMIC CONDITIONS

IDAHO COUNTY

The Selway and Middle Fork Clearwater subbasin assessment area is within Idaho County, the largest and nineteenth most populous county in the state of Idaho. Idaho County has a population density of 1.8 persons per square mile, and 83 percent of the land in the county is federally owned. Population growth has been erratic over a thirty-year period, showing sharp declines in the early 1980s, but steadily growing at an average rate of about 2 percent (Regional Economic Information System, 1998).

The average annual growth rate of per capita personal income (PCPI) was 4.5 percent in 1996, lower than the state of Idaho's, but about the national average. Idaho County had a PCPI of \$15,693. Earnings of persons employed in Idaho County increased 4.6 percent. The largest industries in 1996 were: durable goods manufacturing, 20% of earnings; state and local government, 14.8 percent; and services, 14.8 percent. Timber industry employment was 11.25 percent of the county total and 27.32 percent of total county industry output. Employment associated with grazing and minerals was minimal. Over the past 30 years, government employment has been largest, followed by manufacturing (timber-related and other), which fell to an all-time low in 1982 and has been fluctuating in an upward trend since. The service industry has grown to surpass farming, manufacturing and retail trade (Bear Facts-Regional Information System, Bureau of Economic Analysis, 1998; Implan Model Year Data, 1996). Appendix O provides more information.

RAVALLI COUNTY

Ravalli County, Montana borders the assessment area on the east at the crest of the Bitterroot Mountains. In the past, before wilderness designation, the lands within the assessment area were important for timber and for grazing, and for Forest Service operations based from communities in the Bitterroot Valley. After 1964, the year of the Wilderness Act, those communities evolved into bases for recreational use. Services, retail trade, and durable goods manufacturing account for current economic earnings. Population growth is increasing at a considerable rate. People are attracted to the Bitterroot Valley, seeking the quality of life that the scenic, rural area offers. Long-time local residents feel that their traditional lifestyle is threatened, that the once quiet beauty of the valley is changing, and that the area is taking on the appearance of suburbia.

Much of the recreational use of the assessment area originates in the canyons along the Bitterroot Divide. Roads reach trailheads and popular campsites where large numbers of visitors enjoy motorized recreation use, hiking, riding, and rock climbing. Some local citizens are concerned that the significantly increasing use threatens special places.

OTHER ASSOCIATED COMMUNITIES

Residents of Missoula, Montana enjoy recreation in the assessment area. Substantial numbers of university students and staff visit the Selway and Middle Fork Clearwater subbasins. In addition to the University of Montana, centers for scientific research and education are located in Missoula. Research and planning activities associated with wilderness studies, fire ecology and operations, and environmental organizations originate in Missoula.

The University of Idaho at Moscow has similar ties to this land base. In addition to being a favored recreation site, it is a living research laboratory. Students in forestry, biological sciences, and recreation often serve apprenticeships in the assessment area.

SUMMARY OF SOCIO-ECONOMIC CONDITIONS

The population and economic changes in the assessment area will influence a response to natural resources issues. The following statements are based on information from these sources: U.S. Census Bureau data; Idaho County 1996 Implan Model Year Data; the Economic Assistance

System: Idaho County; and the REIS CD-ROM, U.S. Department of Commerce (see Appendix O).

- The population of Idaho County declined from the 1980s to the 1990s and began a steady increase thereafter. Estimates of current population change (1990-1999) indicate a 9.2 percent increase.
- Population composition is changing as new residents are in-migrating and high school graduates are out-migrating. More of the total population is older.
- The number of housing units has increased, and the number of persons per household has decreased. The number of people involved in agriculture employment or farm ownership has declined. Land is being taken out of agricultural production and put into subdivisions and development. Real estate value has increased.
- Logging and the production of wood products is a significant economic contribution to the communities, however, employment opportunities in the timber industry are declining. Small, private business ownership has increased.
- Economic diversity is important to community resiliency. Employment in service industries continues to increase. Recreation and tourism is a potential source of economic growth.
- Hunting (outfitting and guiding), firewood cutting, and gathering (berries, weaving materials) are economically significant.
- Forest Service employment is a major contribution to the economy. Summer seasonal employment is an important source of jobs.

ASSESSMENT OF HISTORIC AND CURRENT ECOLOGICAL CONDITIONS AND PROCESSES

CLIMATE, AIR QUALITY, GEOLOGY, AND SOILS

CLIMATE

The following discussion of the climate of the Selway-Bitterroot Wilderness is taken from a USDA publication, *Weather and Climate of the Selway-Bitterroot Wilderness* (Finklin, 1983). The general climate of the Selway and Middle Fork Clearwater subbasins is transitional between a north-Pacific maritime climate and a continental climate. The maritime influence is noted particularly by the autumn and winter peak in cloudiness and precipitation over most of the area, although the influence of the maritime climate decreases gradually west and south of Moose Creek Ranger District. July and August are normally the clearest and driest times of the year. January is usually the wettest month, with precipitation ranging from 3 to 10 inches. May and June are spring and early summer high precipitation months, and based on the years 1940 to 1970, monthly averages lie between 0.8 inches at lower elevations to 10.0 at higher elevations.

Precipitation

Precipitation on the Selway River near the Fenn Ranger Station is 38.64 inches annually at an elevation of 1,550 feet, as shown below on Table 4.15. This is the westernmost boundary of the Selway subbasin, close to the mouth of the Selway River. Precipitation at Kooskia for the same period of record shows an annual precipitation of 24.84 inches at an elevation of 1,300 feet. The precipitation and snowfall record at Kooskia is representative of the dryer breakland canyons and low elevation valleys on the lower Middle Fork Clearwater River. Nez Perce Camp is representative of the more southern high elevation, lower precipitation areas; it is at an elevation of 6,587 feet with an average annual precipitation of 35.10 inches. Precipitation is as high as 60 to 85 inches in the Bitterroot Mountains on the Selway-Bitterroot Divide. The average annual precipitation of combined rain and snow is 84.5 inches at Lost Horse, which is on the Selway-

Bitterroot Divide. Precipitation at Mountain Meadows at an elevation of 6,360 feet is lower than Lost Horse with an average annual precipitation total of 47.6 inches.

Table 4.15 shows the monthly average precipitation for the years 1961 to 1990, and average annual snowfall in inches for the Fenn Ranger Station on the lower Selway River, and Kooskia, Idaho on the Middle Fork Clearwater River. The monthly average precipitation is shown for Nez Perce Pass, Mountain Meadows, and Lost Lake.

Table 4.15: Monthly Precipitation 1961 to 1990: Fenn Ranger Station; Kooskia*, Idaho; Nez Perce Camp, Montana; Mountain Meadows, Idaho; and Lost Lakes, Idaho

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
Fenn RS Av. Total Precip. (in.)	4.96	3.46	3.79	3.62	3.42	3.03	1.08	1.52	2.33	2.93	4.20	4.32	38.64
Av. Total Snowfall (in.)	20.2	9.7	2.9	0.3	0.0	0.0	0.0	0.0	0.0	0.3	6.0	16.4	55.90
Kooskia, ID Av. Total Precip. (in.)	2.15	1.50	2.40	2.67	2.84	2.46	1.04	1.37	1.84	2.13	2.43	2.13	24.84
Av. Total Snowfall (in.)	4.5	1.5	.05	0.3	0.0	0.0	0.0	0.0	0.0	0.0	2.0	4.3	13.10
Nez Perce Camp, MT Av. Total Precip. (in.)	5.10	3.70	3.50	2.90	3.00	2.20	1.30	1.40	1.70	2.10	3.80	4.40	35.10
Mountain Meadows, ID Av. Total Precip (in.)	6.6	5.0	5.0	3.4	3.5	3.6	1.2	1.4	2.4	3.1	5.9	6.5	47.6
Lost Lakes, ID Av. Total Precip. (in.)	12.6	9.3	8.9	6.8	6.3	5.5	1.7	2.1	3.8	5.1	10.5	11.9	84.5

*Kooskia data from 1961 to 1987

Summertime precipitation accumulation can vary considerably between years, as a comparison of data from the Moose Creek Ranger Station for combined July to August totals demonstrates. The combined total for July to August 1969 was 0.28 inches, compared to 1975, which showed a total of 6.29 inches. The probability of various rainfall amounts is well correlated with the average rainfall. At Moose Creek Ranger Station, chances of 0.10 or more inches of rain falling in 24 hours decrease from 23 percent in much of June, to seven percent in July to mid-August, and back to 20 percent again in mid-September.

Lightning (or thunderstorm) activity occurs somewhere within the Selway and Middle Fork Clearwater subbasins on an average of about 19 days during July and August, the peak season. This average of storm days decreases to about four in September. Storms occur on about five days in May and seven days in June. Usually the months of May and June are too moist for a high frequency of fire occurrence. The months of July and August have the highest frequency of fire occurrence due to low moisture plus lightning and thunderstorm activity.

Floods

Floods often occur with winter rain-on-snow events or during high intensity, long duration rainstorms. Large floods have been recorded in the Clearwater and Selway subbasins in the years 1948, 1963, and 1974. Flooding from May 1 to June 1, 1948 was the most severe since 1894 in northern Idaho. The Selway River as measured at Lowell, Idaho showed discharges that

were the largest in 60 years of record on May 9, 1948. According to the *Idaho, Floods and Droughts, National Water Summary* (1988-89), floods occurred February 1 to 3, 1963, January 13 to 17, 1974 and in November and December 1995 and 1996. Large precipitation events have occurred in the Selway and Middle Fork Clearwater subbasins, some occurring as rain-on-snow floods and some as high intensity, long duration rainstorms. Precipitation events were recorded in 1919, 1933, 1949, 1968, 1995, and 1996. At the Fenn Ranger Station 9.92 inches of rain fell in January 1995 (*National Water Summary*, 1988-89).

Rain-on-Snow Events: Due to the moist maritime climate affecting the Selway and Middle Fork Clearwater subbasins, rain-on-snow events occur. (Summary of the rain-on-snow process is taken from *Rain-On-Snow in the Columbia River Basin* by Ferguson and others, review draft, 1996). The areas in the Pacific Northwest that are susceptible to rain-on-snow events occur in the Cascade Mountains, and where the warm, moist air flows from the Pacific Ocean into the Columbia Plateau, and up the Snake River Valley to include northern Idaho and northwest Montana. Northern Idaho includes a large part of the Selway and Middle Fork Clearwater subbasins.

Rain-on-snow floods are more likely during cool, wet years. Warm, dry years are less likely to experience rain-on-snow floods. Rain-on-snow events are common where snow is transient in the low elevation zone (below 4,500 feet in the Selway and Middle Fork Clearwater subbasins), and where snow accumulates periodically and can totally melt and accumulate several times a year. Snow accumulation in this zone and rain at high elevations often occur, causing rain-on-snow floods. Most rain-on-snow events occur between late October and February.

Large floods within recorded history on the Selway River occurred in 1933, 1948, 1956, 1964, 1972, 1974, and 1997. The record flood recorded was a 50 to 100-year recurrence flood in 1948; it peaked May 29 at 48,900 cfs. Only one flood on record for the Selway subbasin was considered a rain-on-snow winter flood; it occurred in late fall, 1995. In comparison, winter flood events on the Lochsa River have occurred six times in recorded history. On the South Fork Clearwater River, winter floods have occurred 15 times in recorded history. (For more information on floods and droughts, refer to the hydrology section of this chapter).

Long Duration Rainstorms: Large precipitation events have occurred in the Selway and Middle Fork Clearwater subbasins, some occurring as rain-on-snow floods and some as high intensity, long duration rainstorms. Precipitation events were recorded in 1919, 1933, 1949, 1968, 1995 and 1996. At the Fenn Ranger Station 9.92 inches of rain fell in January 1995 (*National Water Summary*, 1988-89).

Floods often occur with winter rain-on-snow events or during high intensity, long duration rainstorms. Large floods have been recorded in the Clearwater and Selway subbasins in the years 1948, 1963, and 1974. Flooding from May 1 to June 1, 1948 was the most severe since 1894 in northern Idaho. On May 9, 1948 the Selway River as measured at Lowell, Idaho showed discharges that were the largest in 60 years of record. Floods occurred February 1 to 3, 1963, January 13 to 17, 1974 and in November and December 1995 and 1996 (*National Water Summary*, 1988-89).

Temperature

Both elevation and topographic setting influence air temperature. Air temperature is also moderated and affected by the coastal maritime climate that has the strongest effect on the northern and western half of the Selway subbasin and the entire Middle Fork Clearwater subbasin. Moving eastward toward the Montana Bitterroot Mountain Divide, the maritime influence affects temperature less. Along the Selway River near the Fenn Ranger Station, elevation 1,550 feet, the coldest minimum mean monthly temperature is in January at 23 degrees F, and the highest maximum mean monthly temperature is in August at 88.6 degrees F. This is displayed in Table 4.16 below. Large daily ranges occur in the summer between maximum and

minimum temperatures in the canyons; the difference averages about 40 degrees F. Daily maximums range as high as 90 degrees F. The daily range decreases to 15 to 20 degrees F in the late autumn and winter months. Because of inversions, July and August minimum temperatures average lower in the canyon bottoms than at elevations 3,000 to 5,000 feet higher.

The mean monthly maximum and minimum temperature (in degrees Fahrenheit) for the Fenn Ranger Station is shown below for the period of record, 1948 to 1998. Total average maximum and minimum mean monthly temperatures are also displayed.

Table 4.16: Monthly Temperatures at Fenn Ranger Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Av. Max. Temp. (F)	35.6	42.9	51.0	61.3	70.6	78.2	88.5	88.6	76.5	60.8	44.7	36.8	61.4
Av. Min. Temp. (F)	23.0	26.7	30.3	35.4	41.7	47.6	51.4	50.2	44.3	36.8	30.7	25.7	37.0

Humidity averages 40 to 45 percent during most of May and June at the Moose Creek Ranger Station, dropping to 28 to 30 percent during most of July and through mid-August, and back up to 40 to 60 percent by September to mid-October. Winds blow most frequently from the southwest at the Moose Creek Ranger Station, but north or northwest upriver and to the south. At the higher elevations, away from the canyon influences, winds are tied into larger airflows and are predominately from the west or southwest.

Regional Overview of Climate Change in the Columbia River Basin

The Selway and Middle Fork Clearwater subbasins are located within the Columbia River Basin. Like most areas of the basin, both subbasins have transitional type climates. Moist, maritime air from the west moderates seasonal temperatures and has the largest influence in the winter; continental air from the east and south is dry and cold in winter and hot with convective precipitation and lightning in the summer and has a large effect during fire season; and dry arctic air from the north cools the basin in the winter (Ferguson, 1997).

A USDA/USDI publication, *A Climate-Change Scenario for the Columbia River Basin*, contains a discussion of the results of climatic modeling for the Columbia River Basin. The changes in climate were related to disturbance factors, such as floods, fire and drought.

The resulting climate change scenario shows temperatures at lower elevations may increase throughout the year with the greatest increases in the winter. Increases may be as high as 1 to 3 degrees C. If runoff from snowmelt is reduced, and summer temperatures increase, then the incidence of wildfire would go up.

The climate change scenario suggests that precipitation could increase 20 to 50 percent in the winter and 5 to 35 percent during spring and autumn. A decrease of 0 to 5 percent is expected in the summer. At high elevations, due to higher cloud cover, winter average temperatures could decrease, but lower elevation summer temperatures may increase.

AIR QUALITY

Air Resource Management

Air quality impacts associated with fire use activity is increasing in importance as air quality regulations become more stringent. Smoke, whether from wildland fire or prescribed fire, affects

air quality and therefore peoples' health and quality of life. Air quality issues include the direct effects of smoke on visibility, and the potential effects of smoke on human health. It is increasingly apparent that there are tradeoffs between meeting air quality objectives and meeting goals for ecosystem health through prescribed burning (EPA, 1999). Non-industrial smoke is recognized as the primary pollutant of the air in the analysis area. This smoke can be produced locally or can be transported here with the prevailing winds.

Under current rules (state and federal) smoke from wildland fire is considered a natural event and is covered under EPA's Natural Events Policy. Smoke from prescribed fire must meet federal, state, and local air quality regulations. Within the Forest Service's Northern Region, the state smoke management programs, specifically the Montana/Idaho State Airshed Group, are critical in coordinating and minimizing smoke impacts from prescribed fire (Acheson et al., 2000).

Air Quality Regulatory Framework

The Clean Air Act: The framework for controlling air pollutants in the United States is mandated by the 1970 Clean Air Act (CAA), as amended in 1999 and 1990. The CAA was designed to "protect and enhance" air quality. The primary means by which this is to be accomplished is through implementation of National Ambient Air Quality Standards (NAAQS).

The CAA requires measures "to preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreation, scenic, or historic value." Stringent requirements are therefore established for areas designated as "Class I" attainment areas. Class I areas include Forest Service and Fish and Wildlife Service wilderness areas over 5,000 acres that were in existence before August 1977. Designation as a Class I area allows only very small increments of new pollution above already existing air pollution levels. All of the Selway-Bitterroot Wilderness, including that portion in the analysis area, is designated Class I. There are several other Class I airsheds downwind in Montana, such as the Bob Marshall Wilderness Area.

Another requirement of the CAA (as amended) is that new major stationary sources or major modifications of existing stationary sources must first receive a "Prevention of Significant Deterioration" (PSD) permit from the appropriate air regulatory agency before construction or modification of these sources can be accomplished. Montana and Idaho have had the PSD permit program delegated to them by the Environmental Protection Agency (EPA).

PSD permit applicants must demonstrate that the proposed facility will: (1) not violate national or state ambient air quality standards, (2) use Best Available Control Measures, (3) not violate either Class I or II increments for sulfur dioxide, nitrogen oxides, or particulates, and (4) not cause or contribute to an adverse impact on AQRVs in any Class I area (Acheson et al., 2000).

AMBIENT AIR QUALITY STANDARDS

The Environmental Protection Agency has established National Ambient Air Quality Standards (NAAQS) for specific pollutants emitted in significant quantities throughout the country that may be a danger to public health and welfare. These pollutants are called criteria pollutants. The criteria pollutants are carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), ozone, PM₁₀ (particulate matter <10 microns), and PM 2.5.

If a community or area does not meet or "attain" the standards, it becomes a non-attainment area and must demonstrate to the public and the EPA how it will meet standards in the future. This demonstration is done through the State Implementation Plan. Non-attainment areas for Idaho and Montana are displayed in Figures 4.3 and 4.4.

Air quality in the Selway and Middle Fork Clearwater subbasins is generally considered good to excellent most of the year. Local adverse effects result from native-surfaced roads, sporadic

debris, field burning by local landowners, heating homes, and occasional wildland and prescribed fires.

Figure 4.3: Idaho Air Quality Nonattainment and Class 1 Areas

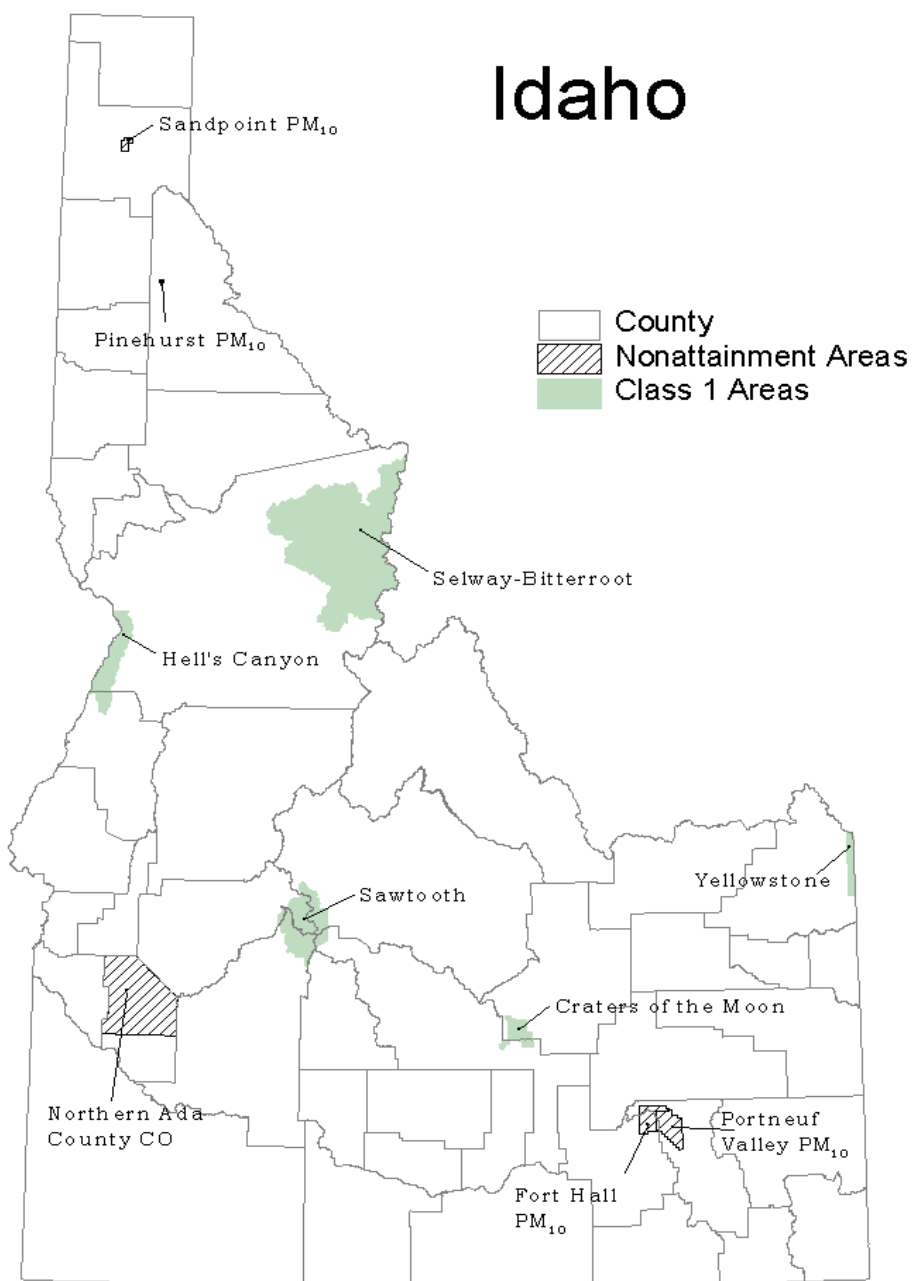
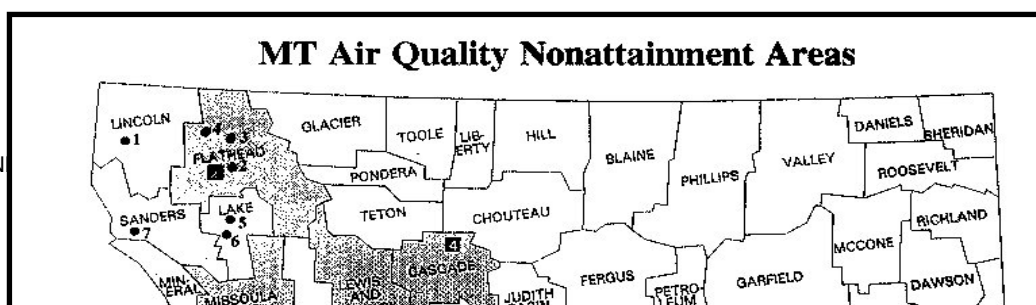


Figure 4.4: Montana Air Quality Nonattainment Areas



The prevailing wind direction in the assessment area is from the southwest, with west winds being the second most common (Finklin, 1983). Frontal storms that occur in the fall, winter, and spring are low intensity, long duration occurrences. Thunderstorms occurring between May and October are accompanied by locally strong winds, and are of high intensity and short duration.

Visibility impairment is a basic indicator of pollution concentrations in the air, and has been recognized as a major air quality concern for many years. Visibility variation occurs as a result of the scattering and absorption of light by particles and gases in the atmosphere. Without human-caused pollution effects, the natural visual range is approximately 150 miles in the West and 70 miles in the East (EPA, 1999).

Processes Affecting Air Quality

The geography and climate affecting air quality in the assessment area are described in several written works (Finklin, 1983; Ternes, 1994). The dominant climatic feature is a prevailing southwest wind. The prevailing gradient is known to carry pollutants from the Selway drainage across the Bitterroot Mountains and into the Bitterroot Valley and the Missoula vicinity. The delivery of smoke from wildfires or prescribed fires to this non-attainment area has become an increasingly important issue.

The Selway and Middle Fork Clearwater subbasins are very lightly populated and without any industrial sources of air pollution. The assessment area is not significantly affected by stationary sources, according to the data contained in *Air Quality Related Values: Management Plan for the Selway-Bitterroot Wilderness Area of Idaho and Montana*. The population is rural and widely dispersed. Dust from roads surfaced with native material and wood smoke from heating appliances are seasonal, and are the primary effects from the rural population. The largest inputs of pollutants to the air in the Selway and Middle Fork Clearwater subbasins come from the burning of native biomass. Smoke production is generally limited to May through October.

Fire history studies and analysis of current vegetation patterns indicate that these subbasins, as well as most others in the Western U.S., have been shaped by natural and anthropogenic fire. The habitats and vegetation patterns have been significantly affected by fire (Smith, 1997). It has also been determined that fire, as a process affecting ecosystem function, has been much

reduced since the 1930s (Brown and Smith, 2000). It can be concluded that with less fire on the landscape currently, there is also less smoke being produced.

Several smoke and air pollution sources are recognized as part of the management of the Selway and Middle Fork Clearwater subbasins:

- Smoke produced locally with only local effects.
- Smoke produced locally with downwind effects.
- Smoke and/or air pollution produced upwind affecting the subbasins and other downwind locations.

The locally produced smoke with local effects may be the most common occurrence. Fires with a definite head or flaming front usually produce a definite smoke column, which when lifted aloft is dispersed by general or transport wind. This is a common daytime scenario. Smoke from less intense fire in the smoldering phase, especially that which is produced at night, never reaches the ridge tops and is not so easily dispersed. This smoke often “sinks” on down-slope winds, pooling in the valleys. Under late summer inversions this smoke accumulates, creating poorer air quality. Research indicates that valley smoke episodes were 1.3 times more likely to occur prior to 1935, in what researchers call the “presettlement period” (Brown, 1994). It has been concluded that smoke event duration and intensity has been less since 1935.

In more remote locations of the Selway and Middle Fork Clearwater subbasins, locally produced smoke from well-designed and well-implemented prescribed fires that follow the Airshed Group recommendations often go unnoticed by the public.

The second smoke scenario is similar to the first. In this case the volume of smoke produced may be very large, or atmospheric conditions may not favor good smoke dispersion, and the outcome is that smoke is delivered to sensitive areas downwind from the source within the Selway and Middle Fork Clearwater subbasins. This is a particularly common concern with natural fire events in the Selway-Bitterroot Wilderness. This type of event can last for 60 days or more. The longer such an event lasts, the more likely it is that the smoke will arrive at a non-attainment area, or in another Class I airshed in the western U.S.

The third scenario involves smoke and/or pollutants from downwind affecting air quality in the Selway and Middle Fork Clearwater subbasins and in non-attainment areas to the east. In 1998 a tremendous dust storm in China brought a dust cloud to the Pacific Northwest and Northern Rockies during the spring prescribed burning season. The dust cloud, large scale prescribed burning on all jurisdictions, and an unusual atmospheric event combined to create poor air quality over large portions of the Pacific Northwest and Rocky Mountains.

Air Quality Management

The planning and management of projects and their relationship to the air quality program requires land managers to determine significance, quantify smoke production, apply mitigation measures, and monitor project implementation.

One task facing specialists and decision makers is determining if air quality impacts from prescribed fire projects are likely to be significant. Following are some general guidelines for determining when an impact may be significant or need further analysis (CH2MHill, 1995):

- The project is highly controversial and therefore likely to receive intense public scrutiny.
- The project is located near a Class I area.
- The project is located near historical or cultural resources, parks or campgrounds, high-use recreational areas, etc.
- The project is located in or near (within 10 miles) a non-attainment area.

The Decision Analysis matrix (CH2MHill and USFS, 1998) is useful to stratify burns based on levels of potential emissions. It identifies which emissions and dispersion analysis models to use. *An Introduction to Smoke Emissions and Dispersion Modeling* (CH2MHill and USFS, 1998) provides a thorough explanation of smoke modeling concepts and available models. The Decision Analysis criteria used to determine the recommended level of modeling includes unit size, fuel loading, associated potential emissions, and distance to sensitive areas.

The FOFEM (First Order Fire Effects Model) is an emissions production model for piled debris or prescribed burns for PM_{2.5}, PM₁₀, and CO (Reinhardt et al., 1997). The FOFEM model inputs include fuel loading by size class, vegetation, density (herbaceous, shrub, and tree regeneration), anticipated fire intensity, fuel moisture, duff, depth, and season of burning.

Mitigation techniques include those used for reducing fuel loading, fuel consumption, smoke incursions, or smoke concentration in sensitive areas. Using such mitigation techniques helps in reducing emissions and impacts. Emission reductions should be quantified if possible.

The operations of the Montana/Idaho State Airshed Group should be emphasized as a method to reduce impacts of prescribed burning. Their full Operating Guide is at <http://www.fs.fed.u/r1/fire/nrcc/smoke/html>.

Monitoring is the post-decision action that is used to determine if the implemented alternative met the site-specific objectives, contributed toward the desired condition, and validated the assumptions used to develop the implemented alternative.

One method that is currently being used to measure the impacts of airborne pollutants is monitoring the acidity of high elevation wilderness lakes. Acid deposition to these lakes can be detected and used as a relative measure of atmospheric pollution.

To monitor NAAQS the Forest Service, the primary administrator of Selway and Middle Fork Clearwater subbasins, is a party to the North Idaho Smoke Management Memorandum of Agreement. There are now standards land managers must identify and comply with for both wildland fire and prescribed fire. The North Idaho Smoke Management objective is to minimize or prevent the accumulation of smoke in Idaho to such a degree as is necessary to protect State and Federal Ambient Air Quality Standards when either conducting a prescribed burn or determining if a wildland fire can burn naturally. The North Idaho Group currently uses the services and procedures of the Montana State Airshed Group. The procedures currently in place are considered to be the best available control technology (BACT) by the Montana Air Quality Bureau.

GEOLOGY

Upper and Middle Selway River Area

The upper portion of the Selway subbasin is mapped mostly as Idaho Batholith Formation (see Map 4). The Idaho Batholith Formation was formed by magmas generated from movement of the eastward moving plate. These granitic magmas were put in place during the Cretaceous period. The batholith intruded and assimilated some of the Belt strata in the upper Selway area. This portion of the Idaho Batholith is widespread in the Selway subbasin, but the Belt metamorphic rocks (gneiss, schist, quartzite) are often found intermingled throughout the upper and middle Selway subbasin.

High angle normal faults trending northeast to north to south are present throughout the middle and upper Selway subbasin. The Yakus, O'Hara Creek, and less extensive sub-parallel faults that cut through the southern valley wall of the lower subbasin control about three miles of O'Hara Creek, and the lower five miles or so of the Selway River. The Coolwater Ridge (tonalite) granitic is relatively free of faults.

The Precambrian Belt metamorphic rocks are some of the oldest rocks in the area. It is believed these rocks were originally deposited in a large, sedimentary basin in Precambrian time (700 million to 1,500 million years ago). The basin encompassed western Montana, northern and central Idaho, eastern Washington, and the southern portions of British Columbia and Alberta. The Belt strata are schists, gneisses and quartzites. Large portions of the middle and lower Selway subbasin and the upper Middle Fork Clearwater subbasin are mapped as Precambrian Belt Metamorphics.

Middle Fork Clearwater River Area

In the Middle Fork Clearwater River subbasin, Precambrian schists and quartzites are present on both sides of the northwest to northeast trending faults. South of the Middle Fork Clearwater River the Yakus fault trends northwest, crossing basalts, with the granites close to the river. From Suttler Creek west along the river, Tertiary basalts dominate the geology. These basalts came in several different flows. The basalts are also referred to as the Columbia River basalts.

Moose Creek Area

The area mapped as alluvium 1 is found mainly in Moose Creek, North Moose Creek and its upper elevation tributaries, and East Moose Creek and its upper elevation tributaries. It is also found in the Selway headwaters, and Deep Creek. This alluvium consists of high terraces such as on Moose Creek, East Moose Creek and North Moose Creek, near their confluence. These terraces are of glacial-fluvial origin, but have been moved several miles from their origin by water, so are considered alluvial terraces. The glacial deposits that occur in the higher elevations of these watersheds are smaller terraces along streams where they were deposited by glacial fluvial processes.

Selway and Middle Fork Clearwater Rivers Terraces

The area mapped as alluvium 2 is found as stream terraces along the Selway and Middle Fork Clearwater Rivers. These were stream deposits and were formed by alluvial processes. Examples of these are Johnson Bar on the Selway River, and the lower terraces between Suttler Creek and Clear Creek on both sides of the Middle Fork Clearwater River.

Mining

Mining in the Selway subbasin has focused on some early exploration in upper Meadow Creek, mining basalt rock for road aggregate, and mining the harder Belt metamorphic for barrier rock and road rock. Rock pits are found in the lower Middle Fork Clearwater subbasin, and Upper and Lower O'Hara Creeks. See Map 4, Geology and Mining of the Selway and Middle Fork Clearwater Subbasins.

SOILS

Soils are the biologically active zone at the interface of earth and atmosphere. Soils regulate movement and storage of energy, water, and nutrients. Soil physical properties such as bulk density and texture affect soil water holding capacity, hydrologic response, and surface stability.

Landslides and Mass Wasting

Some soil disturbances may require hundreds of years for recovery. Surface soil erosion reduces soil productivity. Eroded soil material may be delivered to streams as sediment, affecting water quality and fish habitat. Table 4.18, below, displays the acres of soil with high surface erosion hazard, acres of harvest on high surface erosion hazard, high subsurface erosion hazard, miles of road construction on soils with high subsurface erosion hazard, landslide prone acres, harvest acres on landslide prone areas, road density and miles of road construction on landslide prone areas.

Erosion Processes: The dominant erosion processes that shaped the assessment area have been influenced by geology, landform, and climate. The basalt parent materials in the lower

Middle Fork Clearwater ERU and part of the Clear Creek ERU typically weather into finer textured soils such as clays, or break into large gravel or cobble that do not erode readily. The metamorphosed Precambrian Belt rocks consist of gneiss, schist, and quartzite. These geology types weather into moderately coarse textured material and erode easily. The border zone granitic of the Idaho Batholith weathers to material ranging from coarse textured fine sand to coarse sand material also. The moist, humid climate of the Selway basin increases weathering rates and results in deeper soils than a dryer or colder climate. Volcanic ash occurs in the lower half of the Selway basin and the Middle Fork Clearwater basin on north and east slopes in moist vegetation types and has a large influence on site productivity. The ash soils have a large moisture holding capacity and have a high capacity to resist erosion. All of the above inherent properties have a large influence on how the landscape responds to indicators including high surface erosion hazard, high subsurface erosion hazard, and landslides, which are used as a measure of soil condition in the ERUs and the Selway and Middle Fork Clearwater subbasins.

The Selway basin is mostly wilderness and roadless area. The lower Selway subbasin from the wilderness boundary at Race Creek extending to the mouth of the Selway River encompasses most of the land within the assessment area that has been managed for timber harvest and road construction necessary for the timber transportation system. From the confluence of the Selway and Lochsa Rivers that drain into the Middle Fork Clearwater River downstream to the forest boundary at Clear Creek, timber harvest and roads occur on state, national forest, and private lands.

High Surface Erosion Hazard: There are 547,530 acres of area within the Selway and Middle Fork Clearwater subbasins that have soils with high surface erosion hazard. See Map 5, Selway and Middle Fork Clearwater Subbasin Areas of High Erosion Hazard for a display of the surface erosion areas. Surface erosion from timber harvest units typically is usually slight, except when skid trails are constructed on slopes that are exposed to wind and water erosion without adequate drainage or surface cover such as slash or vegetation. Erosion from harvest units typically declines rapidly with re-growth of vegetation.

A large portion of the analysis area has not been affected by harvest practices on soils with high surface erosion. ERUs that have had noticeable timber harvest on high surface erosion are Clear Creek ERU with 5,990 acres, and O'Hara and Goddard ERU with a total of 3,610 acres. The acres of high surface erosion harvest for each watershed within the O'Hara Creek ERU is shown in Table 4.18, below. The O'Hara and Goddard ERU on the south Selway face has the highest concentration of timber harvest in the lower Selway subbasin. The Middle Fork Clearwater face has 2,327 acres of harvest on high surface erosion soils. This occurs on watersheds on both the north and south faces. Timber harvest has occurred on only 2 percent of the total 547,530 acres of high surface erosion soil in the Selway and Middle Fork Clearwater subbasins.

High Subsurface Erosion Hazards: There are 405,648 acres of area within the Selway and Middle Fork Clearwater subbasins that have soils with high subsurface erosion hazards. See Map 5, Selway and Middle Fork Clearwater Subbasin Areas of High Erosion Hazard, for a display of high subsurface erosion areas. Subsurface erosion is a concern with activities such as road building that expose soil substrata. These areas erode readily and deliver eroded material to streams efficiently. Areas of high substratum erosion occur widely in the subbasins.

The ERUs that have the highest road miles in areas of high substrata erosion hazard are the Middle Fork Clearwater River with 122 miles of road, Lower Selway Canyon with 16.33 miles, Clear Creek with 158.03 miles, and O'Hara and Goddard with 145.59 miles. O'Hara and Goddard ERU includes most of the managed watersheds on the south Selway face such as Falls Creek, Elk City Creek, Goddard Creek, Swiftwater Creek, and O'Hara Creek. Other watersheds have minor amounts of road miles within soils with high hazard for substratum erosion with road building.

Landslides: Landslides, debris torrents, and debris avalanches can deliver large amounts of rock, soil and organic debris to a stream channel under both natural or managed disturbance regimes. Landslide prone areas are shown on Map 7, Selway and Middle Fork Clearwater Subbasin Landslide Prone Areas. Table 4.17 displays acres of landslide prone soils for ERUs and watersheds within ERUs.

Harvest and road building has occurred on landslide prone soils within the watersheds. This can lead to mass wasting such as debris torrents in timber cutting units or fillslope failures on roads, especially after intense summer rainstorms or rain-on-snow events. Recent design standards for timber cutting units and higher standards for road location allow for better detection of mass wasting potential.

About 2,472 acres have been harvested on landslide prone soils in the subbasin assessment area. This has been concentrated in a few ERUs such as Clear Creek with 158 acres of landslide prone harvest, O'Hara and Goddard ERU with 904 acres, and the Middle Fork Clearwater ERU with 352 acres of harvest on landslide prone soils.

Ninety-six miles of road have been constructed on landslide prone soils. Clear Creek ERU has 27 miles of road on landslide prone areas, O'Hara and Goddard ERU has 17.5 miles, and the Middle Fork Clearwater ERU has 32 road miles on landslide prone soils. Other ERUs have smaller amounts of road miles on landslide prone soils.

Clear Creek ERU has the highest landslide prone road density of 2.05 miles per square mile, which is rated high using the *Interior Columbia River Basin Science Assessment* rating. Roads in the lower one-third of the Clear Creek watershed were constructed at the base of landslide prone breaklands. The Middle Fork Clearwater River ERU has a landslide prone road density of 1.77 miles per square mile, which is also high. This includes small face watersheds such as Big and Little Smith Creeks, Swan Creek, Lodge Creek, Tahoe Creek and Big and Little Tinker Creeks. Big Smith and Swan Creeks have very high landslide prone road densities. This is shown on Map 8, Selway and Middle Fork Clearwater Subbasin Road Density on Landslide Prone Soils. Bridge Creek also has high landslide prone road densities. Road decommissioning is ongoing in Big and Little Smith watersheds, and in Bridge Creek on the Clearwater National Forest.

The O'Hara and Goddard ERU contains one watershed, Swiftwater Creek, with a high landslide prone road density of 1.90 miles per square mile, and three watersheds with moderate ratings. These are O'Hara Creek, Island Creek and Elk City Creek. Rackliff Creek in the North Selway Face ERU has a landslide prone road density of 1.12 miles per square mile, which is moderate. About 26 miles of road have been decommissioned in the lower Selway basin within the O'Hara and Goddard ERU, about 20 miles in O'Hara Creek, 5 miles in Goddard Creek, and 0.5 mile in Swiftwater Creek.

Erosion: Soil erosion has also increased in Middle Fork Clearwater River ERU, Clear Creek ERU, North Selway Face ERU, and Meadow Creek ERU from dispersed use of OHVs and motorcycles on the landscape. Most of the damage is on rolling upland landforms and the headwater meadows where OHV travel through wet areas and across the landscape creates new trails and exposes soil to erosion. The soil is also compacted by this use, destroying native vegetation and increasing weed encroachment on less productive soils.

Another source of increased erosion in the wilderness and roadless ERUs is erosion on abandoned, unauthorized or non-maintained trails, heavily impacted sites near alpine lakes, and sites where illegal salt placement has created large eroded areas.

Table 4.17: Activities on Soils with High Surface and Subsurface Erosion Hazard and Landslide Prone Areas

ERU	Cumulative Effects Watershed	Acres of High Surface Erosion Hazard	Acres of Harvest on High Surface Erosion Hazard	Acres of High Subsurface Erosion Hazard	Miles of Road on High Subsurface Erosion Soils	Landslide Prone Acres	Landslide Prone Harvest Acres	Landslide Prone Road Density	Miles of Road Construction Landslide Prone
North Selway Face	Boyd Creek	2,339	0	2,800	.00	659	0	0	0
	Nineteen Mile Creek	1,247	82	1,385	.031	457	7	0	0
	Glover Ck	3,770	0	4,960	.034	1,761	0	0	0
	Twenty-Three Mile Creek	1,098	0	1,551	0	206	0	0	0
	Rackliff Ck	3,909	108	4,778	0.70	1,344	14	1.12	0.25
	Slide Creek	1,682	0	2,167	0.02	704	0	.08	0.08
Upper Selway Canyon	30102 Face Watershed	29,903	0	1,845	0	13,200	0	0	0
	Bad Luck Creek	20,133	0	0	0	6,497	0	0	0
	Crooked Ck	15,150	0	1,695	0	7,736	0	0	0
	Magruder Creek	2,099	0	670	2.74	1,742	0	0.19	0.56
	Upper Selway Basin	15,552	0	18,938	1.71	15,613	0	0	0.004
	Snake Creek	7,176	0	0	0	4,519	0	.076	0
Lower Selway Canyon	30201 Face Watershed	15,314	259	15,087	16.33	5,575	19	0.49	4.65
	Johnson Ck	1,448	0	1,566	0.29	365	0	0	0
Middle Selway Canyon	30203 Face Watershed	43,851	0	22,536	9.46	19,992	0	0.21	4.31
Gedney and Three Links	Three Links Creek	7,490	0	3,624	0	5,450	0	0	0
	Gedney Ck	15,250	0	18,287	5.25	9,340	0	0.12	1.82
Pettibone and Bear	Bear Creek	10,976	0	24,102	0	36,368	0	0	0
	Pettibone Creek	5,386	0	6,929	0	2,170	0	0	0
Clear Ck	Clear Creek	34,403	5,990	34,770	158.03	8,400	1,138	2.06	27.16
Deep Ck	Deep Creek	10,471	0	361	2.93	5,140	0	0.14	1.17
Ditch Ck	Ditch Creek	6,139	0	1,154	0	2,740	0	0	0
Running and Goat	Goat Creek	5,560	0	4,303	0	3,775	0	0	0
	Running Ck	22,030	0	9,501	2.07	10,186	0	0.06	0.85
O'Hara and Goddard	Elk City Ck	1,399	120	1,638	2.72	407	31	1.05	0.67
	Falls Creek	4,222	548	6,583	19.66	2,094	187	0.50	1.67
	Goddard Ck	6,075	737	8,162	23.15	2,009	141	0.47	1.44
	Swiftwater Creek	3,074	499	3,542	14.58	984	193	1.90	2.99
	O'Hara Ck	18,813	1,532	26,547	77.97	6,915	262	0.75	8.04

ERU	Cumulative Effects Watershed	Acres of High Surface Erosion Hazard	Acres of Harvest on High Surface Erosion Hazard	Acres of High Subsurface Erosion Hazard	Miles of Road on High Subsurface Erosion Soils	Landslide Prone Acres	Landslide Prone Harvest Acres	Landslide Prone Road Density	Miles of Road Construction on Landslide Prone
	Island Creek	2,013	174	3,057	7.88	1,255	90	0.90	1.75
Indian Ck	Indian Ck	9,145	0	921	0	6,490	0	0	0
Selway Headwaters	Little Clearwater River	9,415	0	20,589	1.34	5,631	0	0.02	0.21
Martin Creek	Martin Creek	6,012	0	3,689	0	5,084	0	0	0
Meadow Creek	Meadow Creek	62,193	463	56,033	0.32	36,309	38	0.07	4.07
Middle Fork Clearwater River	Middle Fork Clearwater River	49,648	4,893	26,254	122.03	11,717	1,597	1.77	32.29
Otter Mink	Mink Creek	3,495	0	941	0	2,646	0	0	0
	Otter Creek	5,235	0	6,172	0	3,021	0	0	0
Moose Ck	Moose Creek	67,625	0	49,510	0	45,416	0	0	0
White Cap Ck	White Cap Creek	11,444	0	9,001	0	29,125	0	.008	0
Upper Selway Canyon	Wynntest Creek	5,346	0	0	0	2,224	0	0.86	2.15
Total		547,530	15,405	405,648	469.24	325,266	3,717	NA	96.134

Acres of High Surface Erosion Hazard: Acres calculated from Landtype Limits Data Base and GIS.

Acres of Harvest on High Surface Erosion Hazard: Acres calculated from GIS and TSMRS Data Base.

Acres of High Subsurface Erosion Hazard: Acres calculated from Landtype Limits Data Base and GIS.

Miles of Road on High Subsurface Erosion Soils: GIS data layers for roads and Landtype Limits Data Base.

Landslide Prone Area Acres: Landtype Limits Data Base and GIS.

Landslide Prone Harvest Acres: GIS layer, Landtype Limits Data Base and TSMRS.

Landslide Prone Road Density (using Quigley, 1997 road density classes):

- Very High: greater than 4.7 miles per square mile.
- High: between 1.7 and 4.7 miles per square mile.
- Moderate: between 0.7 and 1.7 miles per square mile.
- Low: between 0.11 and 0.7 miles per square mile.
- Very Low: less than 0.1 miles per square mile.

Miles of Road Construction on Landslide Prone Soils: GIS and roads database.

Soil Productivity

Natural and human disturbances have an influence on soil productivity. Timber harvest, road construction, recreation sites such as campgrounds, and trails compact and disturb soils and can lower soil productivity. Reduction of soil productivity occurs through processes such as reduction

of soils aeration due to loss of soil air space, decreasing natural water infiltration rate, and decreasing the ability of plants to produce healthy root systems due to increase in bulk density. Fire is a natural and human caused disturbance that is an important part of the forest ecosystem. Fires that are hot can volatilize some soil nutrients and increase water repellency in soils. Because water cannot infiltrate into the soil, overland flow may occur on water repellant soils, which results in an increase in erosion and sediment carried into stream systems. Woody debris is an important component in soil nutrient cycling. Prescribed fire, natural fire and clearcutting can remove large wood needed for soil nutrients.

Soil Compaction

Soil compaction is the packing together of soil particles by forces at the soil surface that increase the density of soil. The increased density of the compacted soil alters the infiltration of water into the soil, and this in turn alters the runoff patterns of water and soil water availability for plants. Soil displacement removes the nutrient-rich surface soil from a site, and the underlying mineral soil is often more erosive and lower in nutrients. Areas most prone to compaction and displacement have been timber harvest units logged with tractors and where logging slash has been piled with bulldozers. Table 4.18, below, shows the acres of tractor harvest and where logging slash was piled with bulldozers. Typically, on areas that have been tractor logged and not dozer piled, about 15 to 25 percent of the unit has detrimental compaction and displacement, according to analyses contained in the *Nez Perce National Forest Monitoring and Evaluation Reports* (USDA, 1990, 1991). On units both tractor logged and dozer piled, about 30 to 40 percent of the unit has suffered detrimental compaction or displacement. Current forest plan standards state that no more than 20 percent of an activity area may be detrimentally impacted.

Table 4.18: Acres of Tractor Logging and Dozer Piling

Cumulative Effects Watershed	Acres Tractor Logged Only	Acres Dozer Piled (usually tractor logged)
30201 Face Watershed	65	14
Clear Creek	2,645	1,890
Elk City Creek	31	0
Falls Creek	7	0
Goddard Creek	0	17
Island Creek	14	20
Meadow Creek	69	385
Middle Fork Clearwater (Nez Perce National Forest portion)	65	491
O'Hara Creek	160	512
Swiftwater Creek	0	103
Middle Fork Clearwater (Clearwater National Forest portion)	334	271
Total Acres	3,390	3,703

Logging started in the Selway River and Middle Fork Clearwater River basins in the 1950s and 1960s, with the most activity in the 1960 to 1970 decade, with a high level of activity still ongoing in the 1980s and tapering off in the 1990s. Many of the timber harvest units that were tractor logged, or both tractor logged and dozer piled, were entered twice and sometimes three or more times to harvest timber. The area of compaction and disturbance increased with each entry. Some harvest units may have from 30 to 80 percent of the unit in skid trails and temporary roads, in addition to topsoil disturbance and compaction by dozer piling. Prescribed fire, such as broadcast burning and dozer pile burning, has also affected soil productivity in these units.

Large Organic Debris

Large organic debris (down tree limbs, boles and roots) is a critical component of forested soil ecosystems, providing sites for nitrogen transformations, moisture retentions, root-microbial interactions (mycorrhizae), wildlife habitats, and sites for seedling establishment. Decaying logs have an extremely high water holding capacity, and in an advanced decay state may hold 350 percent moisture content in winter and 250 percent moisture content in summer. In western forests, where water is limited, decaying logs function as reservoirs for trees and soil organisms. Tree roots and mycorrhiza associated with roots are associated with decaying wood in dry habitats (Harvey et al, 1986) and the ability of seedlings to access water in soil wood can make the difference between survival and death in droughty south slopes or clearcut areas.

In most fire-prone lands of the Selway and Middle Fork Clearwater subbasins, wildfire is a principal agent in recycling large organic debris, because wood is relatively slow to decompose from microbial activity alone. With fire suppression, periods between fires have been extended, potentially increasing coarse woody debris accumulations and soil productivity. However, the risk of eventual severe fires has also increased, with the potential for loss of this organic material. Such losses could exceed those under the prior presettlement fire regime. Current harvest practices usually prescribe some level of large organic debris retention (10 to 15 tons), although this may be lost during piling of the slash or slash burns that consume the large woody debris left after harvest.

Soil Summary

Soil erosion processes in ERUs without a history of timber harvest and road building have soil erosion processes that are more similar to presettlement conditions than those ERUs where timber harvest and road building occurred. The main departure from historic conditions is the loss of the large pulse disturbances that drive erosion processes, such as wildfire. This is due to fire suppression. This includes ERUs in the Selway-Bitterroot Wilderness, Meadow Creek ERU, and most of the North Selway Face ERU. The erosion processes are driven by fire and flood. Erosion processes contribute sediment in the form of surface erosion and mass wasting. The decrease in fire occurrence in the past 60 years has increased the depth of the surface organic layers on the forest floor, which can lead to higher severity fires when they occur. This results in higher cambium scorch near the ground and burning tree roots close to the soil surface.

The main erosion process related to press disturbance such as timber harvest and roads on landslide prone soils, are mass wasting, surface sediment routed to streams, and surface erosion on harvest units. Long-term soil productivity has been affected the most in Clear Creek, O'Hara and Goddard, and the Middle Fork Clearwater River ERUs. Soil compaction and displacement are attributed to mostly ground-based timber harvest systems and jammer logging. Volcanic ash surface soils are the most susceptible to compaction.

Soil erosion, compaction, and displacement are increasing at a high rate from increasingly popular and uncontrolled dispersed OHV use on Coolwater Ridge, and in the Tahoe, Upper Meadow Creek, and Middle Fork Clearwater areas. Soil erosion and compaction is occurring in the wilderness ERUs from use of unauthorized trails, over used camp areas along the edges of alpine lakes and streams, and other areas of heavy human use.

HYDROLOGY AND WATERSHED

HYDROLOGIC PROCESSES

Hydrography

Hydrography is the scientific description and analysis of the physical conditions, boundaries, flow and related characteristics of the earth's surface waters or the mapping of bodies of water. The hydrography of the Selway and Middle Fork Clearwater subbasins is discussed in this section.

Streamflows: The hydrology of the Selway subbasin is affected by the pattern of precipitation and temperature that is related to the maritime climate, but the flow regime shown on the hydrograph is strongly influenced by the high elevation mountain snowpack that produces a high runoff peak in late May through early July.

Precipitation in the basin ranges from 40 to 70 inches. The Selway River originates in the Bitterroot Mountains at an elevation of 9,110 feet and drops 7,641 feet in 99 miles; the elevation is 1,469 feet at its mouth near Lowell, Idaho. Mean annual runoff in inches for the Selway subbasin averages 27.71 inches. The Middle Fork of the Clearwater River drops 150 feet over 23 miles from Lowell to Kooskia, Idaho. Precipitation on the Middle Fork Clearwater River ranges from 26 to 40 inches per year.

Mean annual discharge for the Selway River was estimated at 3,765 cubic feet per second (cfs) at the mouth of O'Hara Creek, a tributary to the Lower Selway where a USGS (U. S. Geological Survey) gauging station is located. Minimum average monthly flows were estimated at 766 cfs occurring in September and maximum average monthly flows were estimated at 13,540 cfs in May (USGS data, 1930 to 1988). Estimated mean annual discharge for the Middle Fork Clearwater River is 7,050 cfs at Kooskia (Middle Fork Chinook BA, 1995). Peak stream flow usually occurs in late May and is estimated to average approximately 24,900 cfs. Minimum monthly flows typically occur in September at about 1,460 cfs (USDA, 1995). The runoff regime for the Selway and Middle Fork Clearwater Rivers is dominated by spring snowmelt followed by gradual recession to base flows.

The Selway River typically experiences annual peak runoffs from mid May until mid June. Minimum mean monthly discharge for June is 2,950 cfs, and maximum mean discharge for June is 24,400 cfs. June is usually the peak runoff month. The largest flood of record for the Selway River occurred May 29, 1948 at 48,900 cfs. Floods on the Selway River are usually associated with spring snowmelt events in April to June, but in 1995 the Selway River experienced a rain-on-snow flood event on November 30, with a flood peak of 28,900 cfs.

Less than one percent of the flood peaks over base occur during the late fall and winter months with the rest occurring during the spring snowmelt period. In comparison to the Selway subbasin that has one recorded winter flood, the Lochsa subbasin has experienced six recorded winter floods during the period of record; four percent of the floods in the Lochsa subbasin occur in winter. The winter flood with the highest peak on the Lochsa River also occurred on November 30, 1995.

The Lochsa River subbasin is more affected by the maritime climate and a larger percent of the basin is located in the elevations where the rain-on-snow zone occurs, resulting in a higher occurrence of winter floods than in the Selway subbasin. The Selway subbasin in general has a higher elevation upper watershed basin than the Lochsa or the South Fork Clearwater River. The upper Selway subbasin climate is colder, with a stronger Rocky Mountain climatic influence and is less affected by the coastal maritime influence and the rain-on-snow zone. The South Fork Clearwater is a lower elevation watershed and is more strongly affected by rain-on-snow and winter rain storms, contributing to a higher incidence of winter storm peaks. Fifteen percent of the floods over base flows are winter floods.

Historic Floods of the Selway River and Lochsa Rivers: The flood of 1894 is believed to be the largest flood of history for the Lochsa River, as recorded by locals in oral history, but this is unknown as there were no gauging stations at this time (USDA, 1999). The Lochsa and Selway Rivers had large spring floods in common in 1948, 1956, 1964 and 1974. The Lochsa River flooded in 1933 and in November 1995; these two floods were among the six largest floods on the Lochsa. The same years, the Selway River had high water, but not record floods. In 1995, the winter peak on the Selway was a 2 to 5-year event compared to a 5 to 10-year event on the Lochsa. In 1997, the Selway had a peak flow on May 17, which was the fifth largest flood of

record for the Selway River. In all of the 72 recorded years of gauging on the Lochsa River, the largest flood of record was a 40-year event (Hydrology Report, Lochsa Subbasin, 1999). In the period of record for the Selway River the largest flood of record was a 50 to 100-year event.

Table 4.19: Comparison of Historical Floods for the Selway and Lochsa Rivers in Chronological Order

River	Year	Date	Discharge - cfs	Recurrence Interval	Record Flood
Lochsa	1894				No record*
Lochsa	1933	June 10	34,800	25-50 years	2nd
Selway	1933	June 14	33,800	5-10 years	>15th
Lochsa	1948	May 29	34,600	25-50 years	3rd
Selway	1948	May 29	48,900	50-100 years	1st
Lochsa	1956	May 24	28,500	10-25 years	5th
Selway	1956	May 24	41,200	10-25 years	4th
Lochsa	1964	June 8	35,100	40 years	1st
Selway	1964	June 8	43,400	25-50 years	2nd
Selway	1972	June 2	43,400	25-50 years	2 nd **
Lochsa	1974	June 16	32,000	10-25 years	4th
Selway	1974	June 16	43,100	25 years	3rd
Lochsa	1995	November 30	27,900	5-10 years	6th
Selway	1995	November 30	28,900	2-5 years	Not a flood
Selway	1997	May 17	40,300	10-25	5th

* Believed to be the largest event in recent history on Lochsa. ** Same as 1964.

The main tributaries in the upper Selway River --- Moose, Pettibone, Whitecap, Bear, Running, and Deep Creeks --- and other upper headwater tributaries have a runoff regime that is similar to the Selway River. They each drain areas with high elevation headwaters and high snowpacks resulting in late spring runoff. The runoff regimes of the middle and lower Selway subbasin watersheds are varied and complex depending on their elevation and location in the subbasin. Three Links and Gedney Creeks have similar runoff regimes as the upper Selway watersheds, due to their high elevation headwaters in the Selway Crag. They also have mid to low elevation breaklands on their lower reaches.

The runoff regime for Meadow Creek is almost a mirror image to the Selway River when comparing the hydrographs. The watersheds with headwaters at higher elevations offer cool water to the main river during summer low water periods. Watersheds such as O'Hara, Goddard and Swiftwater Creeks have headwaters located in upper elevation rolling uplands and have peak flows similar to the higher elevation watersheds, but may be more effected below 4,500 feet in the lower reaches with rain-on-snow events or winter rainstorms. Small watersheds on the lower Selway face and Middle Fork Clearwater River, such as Smith, Swan, Lodge, and Little Tinker Creeks and other smaller watersheds have earlier peak runoffs and are more prone to rain-on-snow events that cause winter flood peaks.

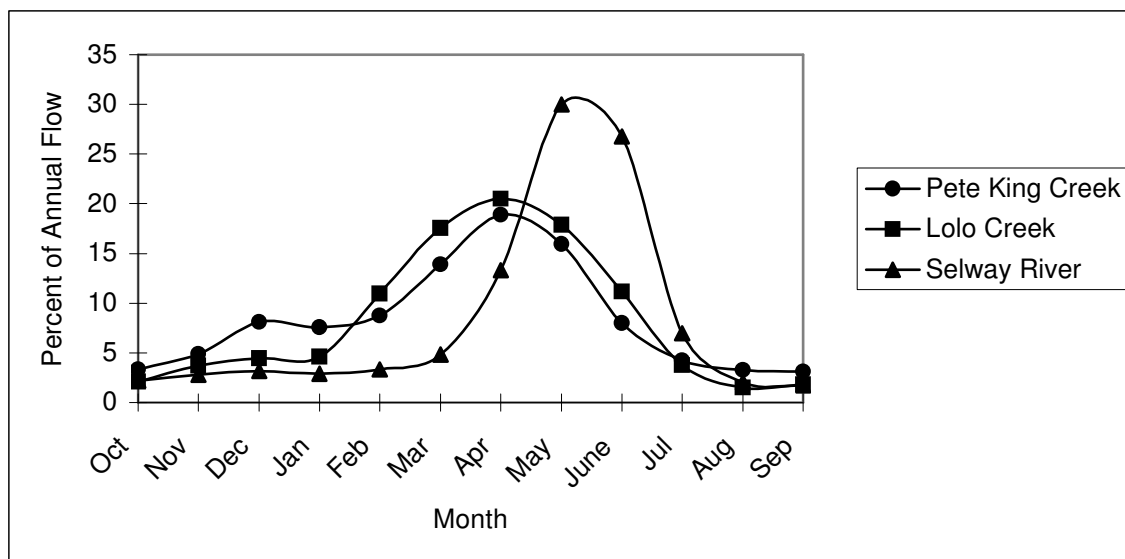
Analysis of Hydrographs: The runoff regime is affected by climatic and topographic variables. By comparing three hydrographs for the Selway River, Pete King Creek, and Lolo Creek various runoff regimes within the Selway and Middle Fork Clearwater subbasins are represented.

The Selway River stream gauge is located on the lower Selway River across from O'Hara Creek. The Selway River hydrograph in Figure 4.5 shows percent of annual flow on the Y axis and months of the year on the X axis. The period of stream gauging record used to create the hydrograph for the Selway River is 1930 to 1988. The hydrograph shows the peak for the Selway River in May, but June is also a high flow month. The Selway basin has large areas above 6,000 feet with high snowpacks, so peak runoff is in late spring. The average date of peak flow for the

Selway River is May 27. The runoff due to snowmelt has the most influence on the shape of the Selway hydrograph. Low flow months occur August to February. The rising limb of the hydrograph starts in March, peaks in June, and falls from late June until August. Winter peaks are uncommon on the Selway River and, as discussed above, only occurred once in November of 1995. This hydrograph also represents Meadow Creek.

The stream gauge for Pete King Creek is located on the mouth of Pete King Creek in the Lochsa River drainage. The Pete King Creek hydrograph is used to represent lower elevation watersheds on the Lower Selway and Middle Fork Clearwater Rivers. Most of these watersheds consist of a small percent of rolling uplands in the headwaters, but with the greatest part of the watershed located in lower elevation breaklands 4,500 feet or less in elevation. The Pete King hydrograph has a rising limb that starts in November and continues until April. Snowpack below 4,500 feet is low and sometimes intermittent. The upper elevations of the watersheds may have up to 2 feet of snow November to March. The runoff regime is complex with a mixture of snowmelt, rain-on-snow and rain resulting in peak runoff events, typically in early spring, but anytime in fall or winter also.

Figure 4.5: Monthly Percent of Annual Flow for Pete King Creek, Lolo Creek, and the Selway River



Lolo Creek stream gauge near Greer, Idaho in the main Clearwater drainage is used as an example to represent a hydrologic regime that is similar to Clear Creek, which drains into the Middle Fork Clearwater River. This hydrologic regime is representative of low to mid elevation watersheds. There is a characteristic February rise in the hydrograph and an April peak. Spring rains may result in a prolonged runoff. Runoff can occur over a longer period of time due to winter and spring rains, rain-on-snow events, and snowmelt. Runoff is not greater in volume, but runoff peaks occur more often with weather events over a longer period of the year. This differs from hydrologic regimes such as for the Selway River, which is mostly related to late spring peak flows due to high elevation snowpack.

Temperature

This section discusses what factors affect the stream temperatures within the Selway and Middle Fork Clearwater subbasins, and in general how physical processes, channel morphology and topography affect stream temperatures. Other influences that affect stream temperatures are:

aspect, elevation, riparian vegetation shading, the human development in stream zones, and natural disturbances such as wildfire.

Solar Energy: Solar radiation is the greatest source of energy for raising stream temperature. Natural topography and the physical characteristics of the stream have a large influence on the inherent temperature of the stream. Factors that affect the amount and impact of solar radiation reaching streams are: latitude; orientation of the stream or river; vegetation height and density next to the stream; gradient; channel morphology including substrate size; stream width; and topographic shading (Amaranthus, 1998).

Topographic Shading: The Selway River and its tributaries are affected greatly by topographic shading. The middle and lower sections of the Selway and Middle Fork Clearwater Rivers are not greatly influenced by vegetative shading, but the exception may be the headwater section of the Selway River above Paradise. The Selway River in that section is narrow enough that large trees in the stream zone probably have some effect on temperature. Also in that section the road next to the stream affects temperature.

Steep canyon sideslopes influence stream temperatures in most of the Selway and Middle Fork Clearwater subbasins. At certain times of the year, topographic influences can partially or totally shade the river due to steep ridges blocking the sun. On short days in the winter, the north aspects on the river may receive little or no sun. This topographic shading occurs mostly in early morning and late afternoon when the percentage of the daily solar radiation is minimal. This is only a general example because the rivers meander and change orientation over small distances, which effects shading and direct solar radiation.

Vegetative Shading: Smaller streams are affected both by topography, vegetation density and vegetation height. For example, on east to west running streams, vegetation on the south side of the stream is critical for providing shade, and the north side vegetation does not have much influence on shade. At midday more solar radiation reaches the stream. With a north to south oriented stream, the eastside vegetation provides morning shade and the westside vegetation provides afternoon shade. Vegetation that is sparse or poorly stocked provides less effective shade than thick dense stands. Taller vegetation provides shade a greater distance from the stream. Tall vegetation directly next to the stream can provide shading against high sun angles during the critical midday high solar radiation period.

Stream Width: Stream width affects how long the stream is exposed to solar radiation and the duration of exposure. A wider more exposed stream warms up faster than a narrow less exposed stream. If streams are equal width, shallow streams warm up faster than deeper streams.

Water Sources: Warm and cold water sources are another influence on stream temperature. Warm water sources may be natural thermal hot springs, several of which occur in the Selway subbasin. Cold water sources include cold water springs in the stream, lateral seeps, and pool bottom seeps. These may be important cold water refuge areas for salmonids.

Channel Morphology: Other aspects of channel morphology such as slope, channel bed characteristics, and substrates also affect stream temperature. Streams that have steep gradients have higher velocities and are not exposed to direct radiation as long; there is less time for the water to heat up. Streams with lower gradients act just the opposite. Streams that have large substrate and bedrock bottoms do not heat up or cool down as rapidly as streams with sand or gravel substrates (Amaranthus, 1998).

Daily Cycle: On a daily basis, stream temperatures cycle from a daily minimum just after dawn to a daily maximum in late afternoon and lag behind the minimum and maximum air temperatures (Stefan and Preud'homme, 1993). This is called diurnal temperature. The range between daily minimum and maximum temperatures is less in larger streams due to their higher heat capacity, but large streams are generally warmer than small streams. In small streams, the amount of

shade provided by vegetation has the greatest influence on daily maximum temperatures due to the reduction in heating from direct solar radiation (Beschta, 1997).

Land Use Effects on Stream Temperature: Loss of streamside shade can be caused directly by human activity or by natural processes. Activities such as logging, fire, road construction, windstorms, grazing, mining, and flooding are all disturbances that can reduce shade and affect stream temperatures. Increasing solar radiation to the stream is the greatest single source of energy for raising stream temperatures (Amaranthus, 1998).

Removal of vegetation along the riparian zone by clearcutting increases direct solar radiation. Even though this was a common occurrence in the past, stream buffers that are retained during present day management reduce the occurrence of vegetation removal in riparian zones. Prescribed or natural fire within the riparian zone can also increase solar radiation. Changes in stream morphology can affect stream temperature. For example, aggradation of low gradient stream reaches often results in a wider and shallower stream. Breakdown of stream banks by grazing also results in a wider, shallower, dished-shaped stream. These physical changes produce a wider, shallower stream that results in increased stream temperatures. Lateral expansion of the channel, whether due to aggradation or erosion within the channel, subsequently increases stream temperatures (Brown 1969; Hawkins et al., 1997).

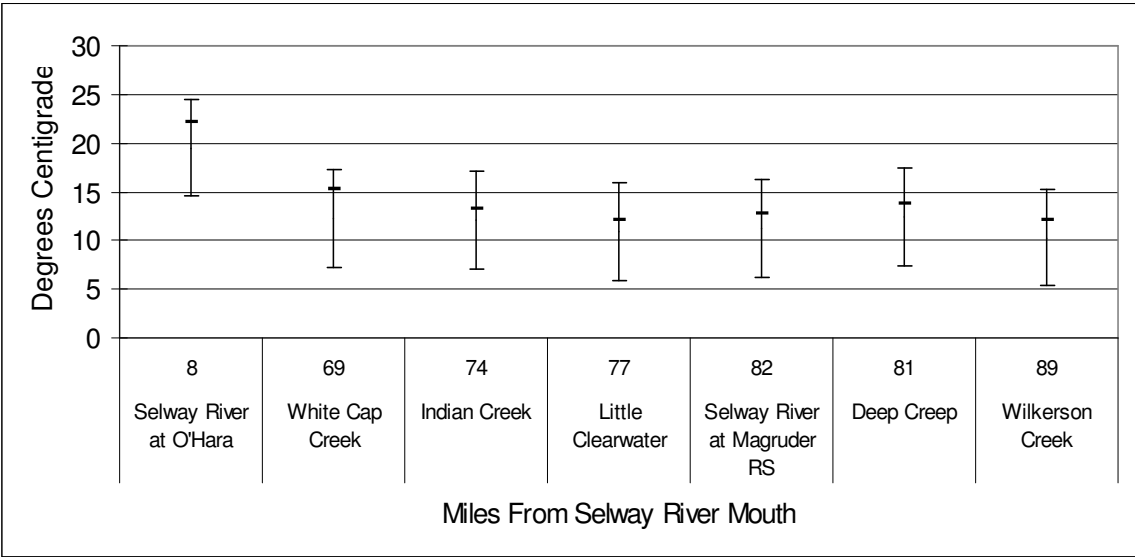
Analysis of Selway and Middle Fork Clearwater Subbasin Thermograph Data: Thermograph data for the Selway and Middle Fork Clearwater subbasins are fairly limited (thermographs are used to record stream temperature). This analysis looks at points in time, specifically, August 1997 and 1998 for the Selway subbasin and August 1998 for the Middle Fork Clearwater subbasin.

Very little historic data exists for stream temperature in the Selway and Middle Fork Clearwater subbasins. Most of the Selway subbasin is included in the Selway-Bitterroot Wilderness, with part of the upper subbasin administered by the Bitterroot National Forest. The lower part of the Selway subbasin below the Selway-Bitterroot Wilderness boundary and the Middle Fork Clearwater subbasin have been affected by human actions, such as road construction and timber harvest. Wildfire is the main disturbance that could affect tributaries of the Selway River in the wilderness sections at large scale.

This analysis simply represents a description, using the little data available, of the Selway and Middle Fork Clearwater Rivers and a few tributaries. The objective of Figures 4.6, 4.7, and 4.8 is to display stream temperature changes from a subbasin-wide view. The figures show a relationship in the subbasin; stream temperatures are cool at higher elevations, and they are cooler the farther the temperature monitoring point is from the mouth of the stream. The mean monthly temperatures are lower upstream and at higher elevations. Figures 4.6, 4.7, and 4.8 also compare differences in mean stream temperatures between monitoring sites in the Selway subbasin for the years 1997 and 1998, and in the Middle Fork Clearwater subbasin for 1998.

August 1997 Minimum, Maximum, and Mean Temperatures for the Selway River and Tributaries: As shown in the August 1997 thermograph data for the Selway subbasin displayed in Figure 4.6, the range of maximum, minimum, and mean temperatures in the mainstem Selway River at the O'Hara Creek gauge is greater than that of the mainstem at the Magruder monitoring station on the upper Selway River and stations near the mouths of the upper Selway tributaries.

Figure 4.6: August 1997 Minimum, Maximum, and Mean Temperatures for the Selway River and Tributaries



The mainstem Selway at O'Hara Creek Campground is wider, and has a slower velocity and much lower gradient than the mainstem Selway at Magruder, and is eight miles from the mouth of the Selway River. The water in the river at O'Hara Creek Campground has flowed through a long stretch above that is exposed to direct solar radiation, so it has had a much longer time to warm without a narrow canyon influence to shade it. This point on the river is prone to summer heating and more diurnal fluctuation than the Magruder site, which is 80 miles from the mouth of the Selway River, much higher in elevation, and located in a narrow canyon.

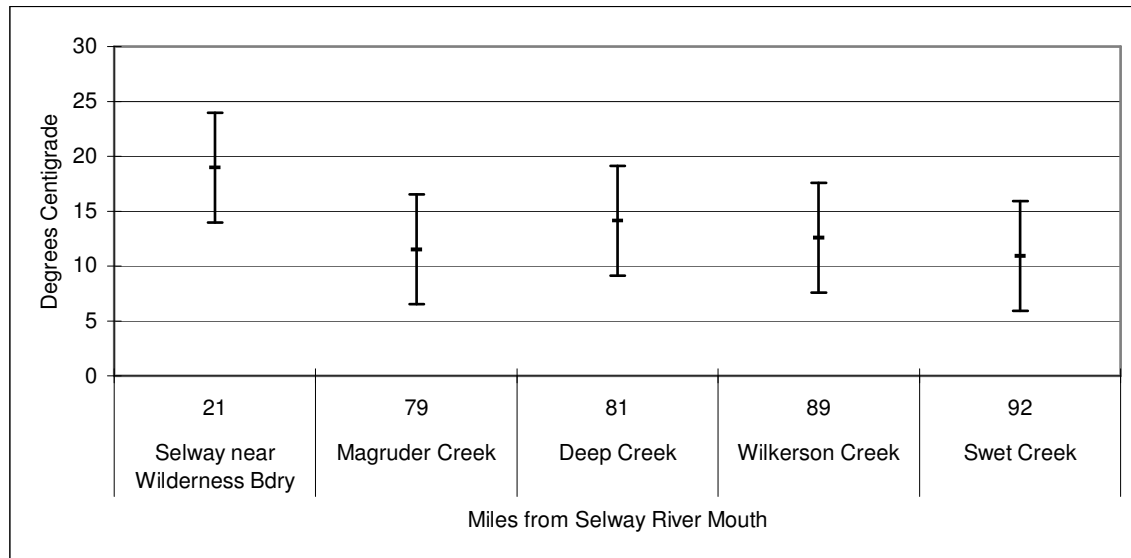
White Cap Creek is the largest of the tributary streams shown in Figure 4.6. The range between the maximum and minimum temperatures is the highest for the White Cap Creek monitoring site. The mean temperature is also higher than the other tributaries shown. White Cap Creek is large, and is wider, shallower, and longer than most of the other streams in the upper Selway area. This allows for more chance of increased solar radiation, resulting in warmer temperatures than in other streams. Much of White Cap Creek in general has a west and south aspect, which may also raise stream temperatures. The headwaters of White Cap Creek are in the rocky crags of the Bitterroots; this keeps temperatures low in general, compared to the lower sections of the mainstem Selway River.

Deep Creek has a higher mean temperature than some of the other headwater tributaries. A main road runs for several miles directly along Deep Creek. The shade-providing vegetation has been removed from one side of the stream in some stream reaches, so solar radiation is increased along the length of the stream where the road is located. This loss of shade-providing vegetation also leads to higher and lower diurnal temperatures. Deep Creek also has a west aspect that may have an influence on increased stream temperatures.

The Little Clearwater River monitoring site has the coolest mean temperature for the month of August. The Little Clearwater River is much smaller than White Cap Creek. The headwaters in Burnt Knob Creek start as high as 8,000 feet, and in general the Little Clearwater River has a steeper gradient and narrow valley bottom that helps keep stream temperatures lower. Other tributaries displayed have mean temperatures that are similar.

August 1998 Minimum, Maximum, and Mean Temperatures for the Selway River and Tributaries: The August 1998 thermograph data for the Selway subbasin shown in Figure 4.7 displays stream temperatures for the Selway River mainstem at the wilderness boundary, and for tributaries in the upper Selway subbasin near their mouths. Magruder Creek, in the upper Selway subbasin, has a mean temperature of around 12 degrees C, compared to a mean of 18 degrees C at the wilderness boundary. Wilkerson Creek has a mean of 16.1 degrees C for 1997 and 19.3 degrees C for 1998.

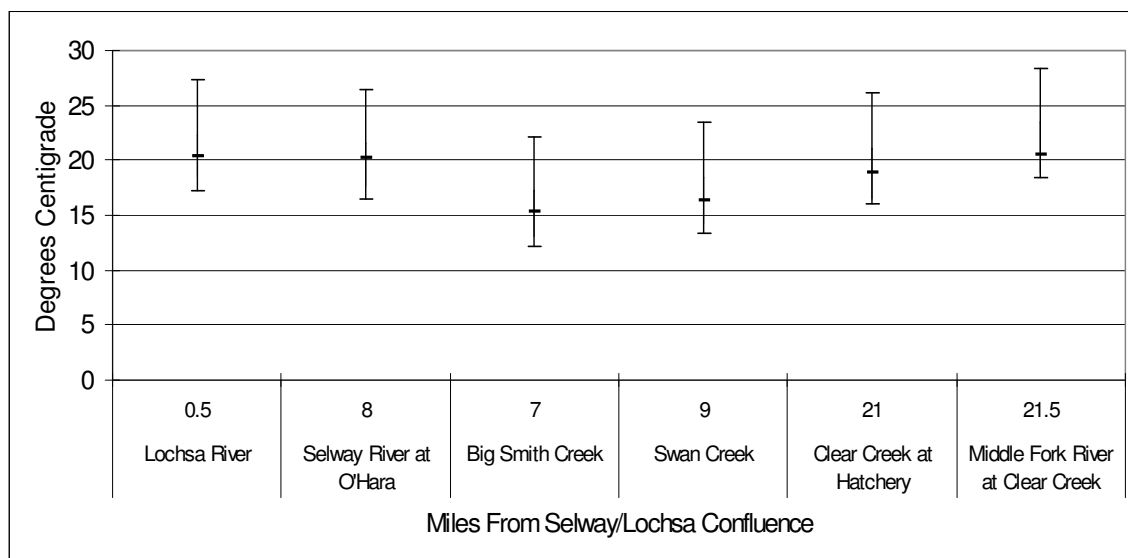
Figure 4.7: August 1998 Minimum, Maximum, and Mean Temperatures for the Selway River and Tributaries



August 1998 Minimum, Maximum, and Mean Temperatures for the Middle Fork Clearwater River and Tributaries: Figure 4.8 displays the August 1998 temperatures for the Middle Fork Clearwater subbasin from Lowell to the Nez Perce National Forest boundary at Clear Creek. Mean temperatures of the Selway River at O'Hara Creek are similar to those on the Middle Fork Clearwater River. The monitoring site about one-half mile from the mouth of Clear Creek at the hatchery also has a similar mean. The Selway River and Middle Fork Clearwater River, and the lower portion of Clear Creek are reaches that all have long days of solar radiation during the month of August and show fairly high mean temperatures for the month. Big Smith and Swan Creeks are smaller sixth code watersheds that have steeper A and B channels that are narrow and heavily shaded by vegetation and steep canyons, so mean temperatures stay cooler throughout the summer.

The temperature for the Selway River at O'Hara was 19.5° C and in 1998 the mean was 20.3° C at the wilderness boundary. These two mainstem monitoring sites have had temperatures within 1 degree C of each other for several years of monitoring.

Figure 4.8: August 1998 Minimum, Maximum, and Mean Temperatures for the Middle Fork Clearwater River and Tributaries



Temperature Conclusions: Historic data for water temperature in the Selway and Lochsa Rivers with continually monitoring thermographs were not available before the 1980s. Some spot temperature information was collected earlier. The lower Selway and Middle Fork Clearwater Rivers have relatively warm temperatures when compared to the tributary streams. This is most likely a natural occurrence, due to high summer temperatures, reach characteristics, and distance from the mouth of the river. There may be a slight increase in stream temperatures in the lower Selway below the wilderness boundary, but this increase would be very slight, less than a mean temperature difference of 1 degree C.

Tributary streams that may be affected by road construction and timber harvest are lower O'Hara Creek and Clear Creek. Some other streams may have slight temperature changes, but monitoring data are not available.

Tributaries higher in the subbasin have cooler mean temperatures and provide cold water input for the mainstem Selway during the summer months.

Water Yield

Water yield refers to streamflow quantity and timing. It is important because streamflow is a key determinant of the energy available for erosion, transport, and deposition of sediment within channels. Streamflow is also a key component in determining the morphology of channels, with implications for the quality and quantity of fish habitat. Water yield is an important component in determining the availability and suitability of water for beneficial uses.

Water yield quantity and timing can be altered by vegetation growth or removal. Water yield generally increases after timber harvest or fire through a reduction in transpiration and a reduction of the interception of precipitation. Changes in the type or distribution of vegetation can affect snow accumulation and melt rates, as well as the amount of moisture returned to the atmosphere by evapotranspiration. Therefore, the vegetation on the landscape has an affect on the total amount of water that flows off the landscape (water yield), as well as how quickly it flows off the landscape (and therefore the magnitude of peak flows). Increased water yields may be associated with channel scour, bedload movement, or redistribution of sediment in depositional areas.

Equivalent Clearcut Area (ECA): Water yield increases can be directly modeled, but equivalent clearcut area (ECA) is often used as a surrogate. ECA is expressed as a percent of watershed area. ECA as an index represents the original percent of the watershed where vegetation was removed. Declines in the ECA percent over time are modeled as a function of vegetation recovery, and the rate depends on the potential rate of recovery on that forest site. Rate of recovery is related to precipitation, elevation, aspect and soil fertility. ECA is used as a procedure to index the effects of disturbance on streamflow (King, 1989).

Within the Selway-Bitterroot Wilderness and a large portion of the roadless area in the Selway subbasin, fire is the main historical disturbance in the watersheds. In the lower Selway subbasin below the wilderness boundary, and in the Middle Fork Clearwater subbasin, road construction and timber harvest are additional disturbances that are included in the ECA index.

Fire history for the Selway River and Middle Fork Clearwater River subbasins was mapped by fire year and severity class (low, moderate, high) by Green (1999), to provide a basis for inference of date and severity of fire impacts on the watershed. This historical fire mapping was used to estimate percent of canopy removed in the watershed as a result of wildfire.

Large fires occurred over much of the Selway River basin in 1889, 1910, 1919, and 1934; these fires were severe enough to reduce tree canopy up to 50 percent in some watersheds. These four major fire years historically were the largest recorded wildfire years in the Selway-Bitterroot Wilderness. Other large fires occurred in these watersheds more recently than 1934. The ECA in the wilderness watersheds began to decrease, in general, as recovery of vegetation in the watersheds occurred in the period after 1940 and up to the year 2000. This may be partially due to fire suppression and may also be related to natural fire cycles that occur through time. The ECA percent that existed in 1870 is unknown, so it is not considered in the displays of historical ECAs on the graphs. Because stand recovery has a large influence on ECA, the recovery is much slower than the recovery of sediment yield, and the existing ECA in 1870 may have ranged from 0 to 60 percent in any one watershed. Sediment yield often decreases within one or two years due to recovery of ground cover vegetation, such as grasses, forbs, and shrubs which protect the soil from erosion.

The following analysis shows the ECA in selected watersheds in the Selway and Middle Fork Clearwater subbasins. The graphs show the history of ECA from the period of 1870 through the year 2000, reflecting wildfire and management activities such as timber harvest and road construction. Wildfires had the main effect on ECA in the watersheds from 1870 to 1940, with ECA peaks from 10 to 60 percent in the watersheds. Timber harvest and roads, in combination with existing ECA from wildfire, had the most effect after 1940, with ranges in ECA from 10 to 60 percent in the watersheds.

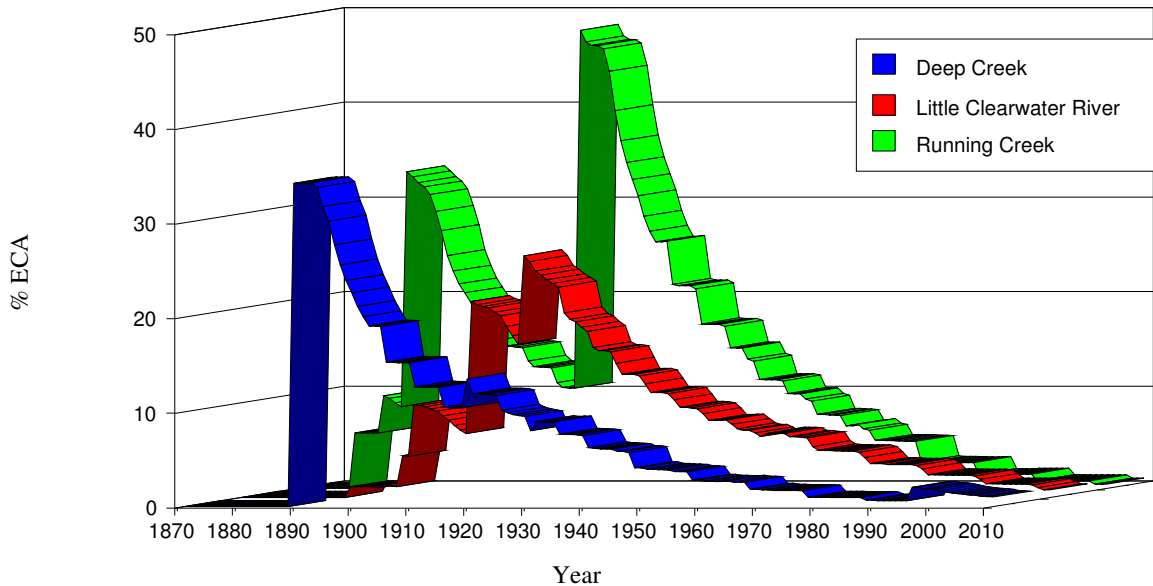
The records of ECA are based on mapped vegetation for the wildfire events since the 1870s. There is very little written record on wildfire before this period. It is unknown to what extent ECA varies within watersheds and subbasins over longer periods.

Selway Subbasin: This analysis for the Selway subbasin shows that streams within the Selway subbasin sustained increased water yields considerably above current levels from 1870 to 1930. It is difficult to assess what the effects were to stream channels as a result of increased ECA. Road encroachment and increased water yield are recent impacts on stream channels since 1960.

Deep Creek, Little Clearwater River, and Running Creek Watersheds: Figure 4.9 shows the overall ECA in the upper Selway subbasin for the Deep Creek, Running Creek, and Little Clearwater River watersheds. The northern headwaters of Deep Creek watershed burned in a wildfire around 1889, which resulted in an ECA of around 30 percent. There was also a slight increase in 1920, but ECA for Deep Creek watershed drops gradually from around 10 percent in

1920 to <1 percent in 1970. There is a slight increase in ECA around 1930 when the road along Deep Creek was constructed, but the small clearing width for road construction has a very small effect on ECA.

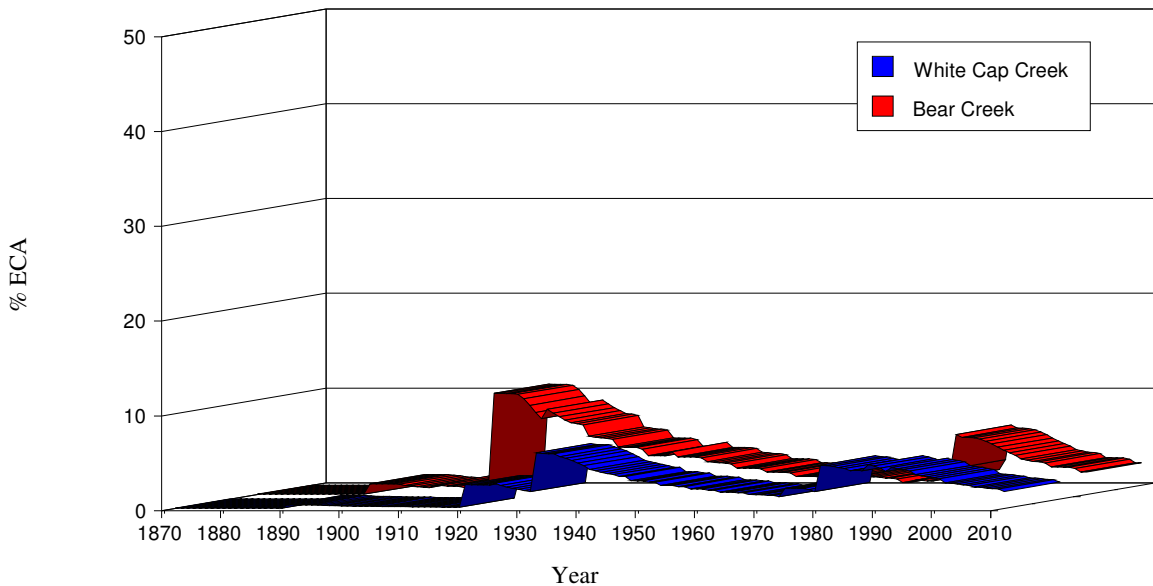
Figure 4.9: Percent Equivalent Clearcut Area: Deep Creek, Little Clearwater River, and Running Creek Watersheds



The ECA for the Little Clearwater River watershed peaked three times over a 30-year period: at 8 percent in 1910, 20 percent around 1919, and 23 percent around 1925. Two of these fire periods occurred in two of the large fire history years of 1889 and 1910. In 2000, a wildfire burned in the Little Clearwater River watershed; 38 percent of the watershed burned, 5 percent at high severity, 8 percent at moderate severity, with the rest at low severity. This fire peak is not shown on the graph above. The estimated first year fire peak flow increase for Flat Creek, a tributary of the Little Clearwater River, was around 30 percent. The Running Creek watershed peaked between 1880 and 1890 at around 33 percent ECA, and again in the 1919 at 48 percent. From the 1920s to the current time the ECA in Running Creek watershed has gradually decreased. Around 1 percent of Running Creek watershed burned in 2000. This is not reflected on graph 4.9. The pattern illustrated by these three watersheds is representative of other wilderness watersheds that were modeled for ECA. Between 1880 and 1940 several peaks occurred due to wildfire, followed by a quick recovery. The ECA has gradually declined to almost 0 percent in all watersheds. This is probably due to fire suppression in the past 60 years.

White Cap Creek and Bear Creek Watersheds: Figure 4.10 displays the historic ECA for the White Cap Creek and Bear Creek watersheds. The main disturbance in the two watersheds is historic fire. The fires that have occurred since 1870 have not been large stand-replacing fires that have burned large portions of the watersheds. The upper halves of the watersheds are at higher elevations, with snowpacks for a large portion of the year. The pattern of ECA peaks on the graph shows lower intensity, lower severity, and smaller fires than watersheds lower in the Selway subbasin. The highest peak in ECA in Bear Creek watershed was in 1920 at 10 percent, and the ECA remained around that level until 1920. After 1920, the ECA decreased slowly until around 1988 when it peaked at 5 percent, and then decreased to the current ECA of 2 percent. White Cap Creek watershed has the highest peak in ECA around 1941 at 6 percent, and has decreased to the current level of 3 percent. ECA recovers fairly quickly after each small fire, with this pattern continuing with small fires in the recent past.

Figure 4.10: Percent Equivalent Clearcut Area: White Cap Creek and Bear Creek Watersheds



Three Links Creek and Gedney Creek Watersheds: Figure 4.11 shows the overall ECA for the Three Links Creek and Gedney Creek watersheds. Most of the Gedney Creek watershed was burned by fire in 1910, with more fire in the 1920s. The ECA for the first large wildfire in Gedney Creek watershed produced an ECA peak of 60 percent, burning about 80 percent of the watershed around 1910. An extremely large fire occurred again in the 1930s with an ECA of 60 percent, burning again a large portion of the watershed. Three Links Creek watershed has a similar fire history, but with smaller ECA peaks. These watersheds represent the ECA patterns on the north Selway face of the lower Selway River below the wilderness boundary. These watersheds have a good portion of lower elevation breaklands with a long snow-free season, and south and west aspects where soil and vegetation dry out faster, which results in a longer and drier fire season. Fires are larger, have a higher severity, and burn large portions of the watersheds. These fires have probably had long-term effects in shaping stream channels, especially in the steep headwaters and breaklands where debris torrents occur after large fires. After the large fires in the first half of the twentieth century, the ECA has gradually recovered and dropped to almost 0, except for recent fire in Three Links Creek watershed.

Meadow Creek and O'Hara Creek Watersheds: Figure 4.12 shows that the Meadow Creek watershed has a fire history similar to that of the wilderness watersheds in the upper Selway subbasin. Meadow Creek shows an ECA peak of 8 percent from about 1880 to 1890, a 12 percent peak in ECA around 1910, and the largest peak of 42 percent ECA between 1910 and 1920. Over half of the watershed burned in the period from 1910 to 1920. After 1930, the ECA gradually drops to <1 percent by the year 2000.

The O'Hara Creek watershed has two peaks caused by historical wildfire, one peak of 10 percent ECA around 1900 to 1910, and the largest peak around 1910 to 1920 of 35 percent ECA. This is similar to the wilderness watersheds, with the peak of 35 percent starting to decrease around 1935, and continuing to decrease gradually to 9 percent around 1960. Timber harvest and road building in the 1960s increased ECA to 12 percent, where it remained until it started to decrease again in the 1980s, gradually leveling out in 2000 at 9 percent.

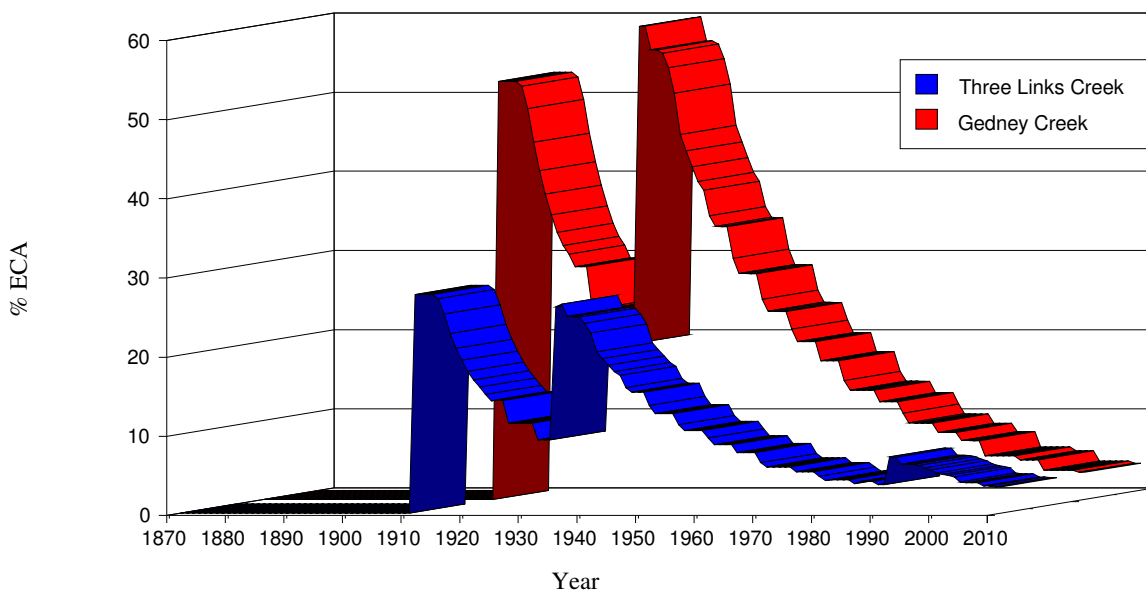
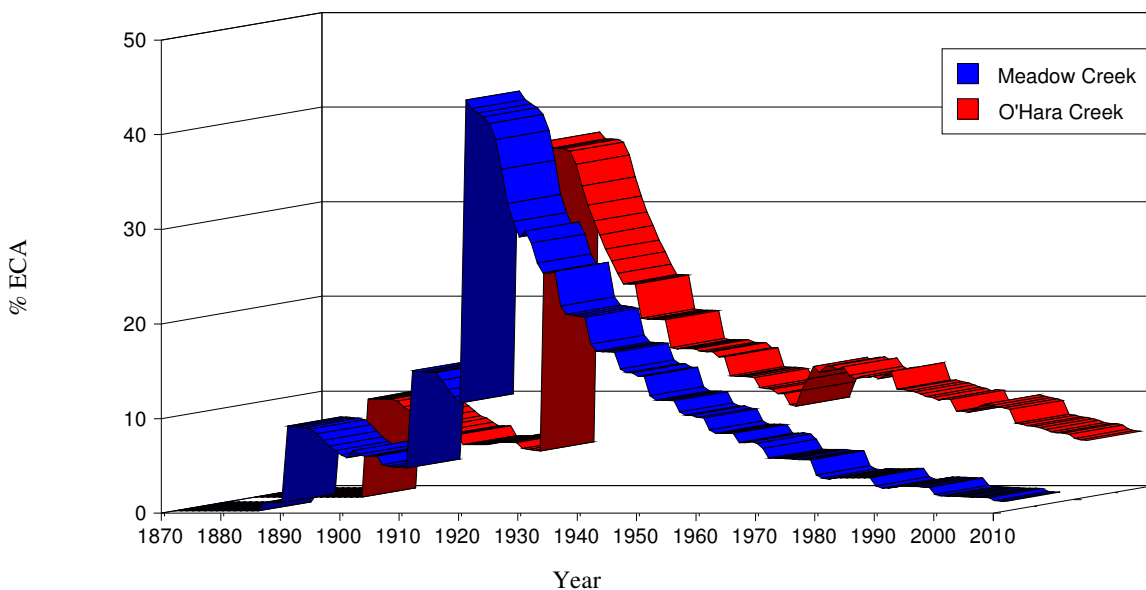
Figure 4.11: Percent Equivalent Clearcut Area: Three Links Creek and Gedney Creek Watersheds**Figure 4.12: Percent Equivalent Clearcut Area: Meadow Creek and O'Hara Creek Watersheds**

Figure 4.12 comparing Meadow Creek watershed ECA to O'Hara Creek watershed ECA illustrates that O'Hara Creek watershed, historically, had similar disturbance patterns from wildfire as Meadow Creek watershed and other watersheds in the wilderness. After around 1935, the watersheds start to recover and ECA decreases. The recovery continues in Meadow Creek watershed and the ECA decreases on through the current year to <1 percent. Around the late 1960s, the ECA in O'Hara Creek watershed increases slightly and maintains a level above 10 percent. It stays above 10 percent due to the presence of roads and continued timber harvest through the 1980s. With the decrease in road miles and reduction in timber harvest, ECA in O'Hara Creek watershed will continually decrease as stands recover. This pattern displayed by O'Hara Creek watershed is representative of roaded and harvested watersheds on the north Selway face. Trends for O'Hara Creek watershed show that there was a change from historical

pulse disturbances to press disturbances such as road construction and timber harvest. Water yield and streamflow regimes in Meadow Creek watershed were dominated historically by pulse disturbances. Fire suppression has had the most effect on decrease in pulse disturbances in Meadow Creek watershed. The small amount of road building and timber harvest has not greatly increased the effect of press disturbances related to ECA, when comparing Meadow Creek watershed to O'Hara Creek watershed.

Water Yield Trends for the Selway Subbasin Watersheds: The Selway subbasin was historically dominated by pulse disturbances such as wildfire and floods. The cycle that is evaluated in this section looks at a small point in time of the fire history in the Selway tributary watersheds. There is an interconnection between the sediment and water yield regimes due to the changes in stream channels when water yield and sediment increase simultaneously after fire. The Selway subbasin has a history of several large fire occurrences between 1880 and 1935. The increase in water yield in the watersheds is related to the severity, intensity, and size of the fire in determining how much of the vegetative cover is removed in a watershed.

Watersheds in the high elevation headwaters of the Selway subbasin have long periods of snow cover. Fires are smaller and burn a smaller percent of the watershed area, when compared to watersheds such as Gedney Creek in the lower subbasin. The effect on water yield in these watersheds due to runoff after fire produces smaller peak flows, and probably has less effect on in-channel erosion and scour in stream channels. The largest influence on water yield and streamflow regime in these watersheds is still pulse disturbances such as fire and flood, and the decrease in pulse disturbances due to fire suppression.

Watersheds that were modeled in this analysis, such as Little Clearwater River and Running Creek, and other watersheds modeled but not displayed such as Moose Creek and its North and East Forks, Ditch Creek, and Otter Creek have similar patterns for ECA. Several ECA peaks from 15 to 40 percent occurred during the 1880 to 1935 fire period. Following this period, the peaks have recovered gradually. After 1935, all of the ECAs in the watersheds decrease gradually to almost 0 percent, and stay there until the year 2000. This is probably due to fire suppression and the loss of large-scale pulse disturbances in the watersheds.

The watersheds where management activities have occurred show similar ECA patterns to the wilderness and roadless watersheds until around 1960. After timber harvest and road construction start, ECA never decreases to 0 percent, but remains elevated at some point until timber harvest decreases. These watersheds have lost the influence on water yield and streamflow regimes related to large scale fire pulse disturbance and are influenced strongly by press disturbances such as timber harvest and road construction.

Stream channels evolved with sediment regimes and water yields tied to large pulse disturbances. The effects of long-term chronic sediment and increased water yield over prolonged periods, such as the past 40 years of management, are not fully known. The balance of water yield and sediment input into the system is definitely altered under the management regime.

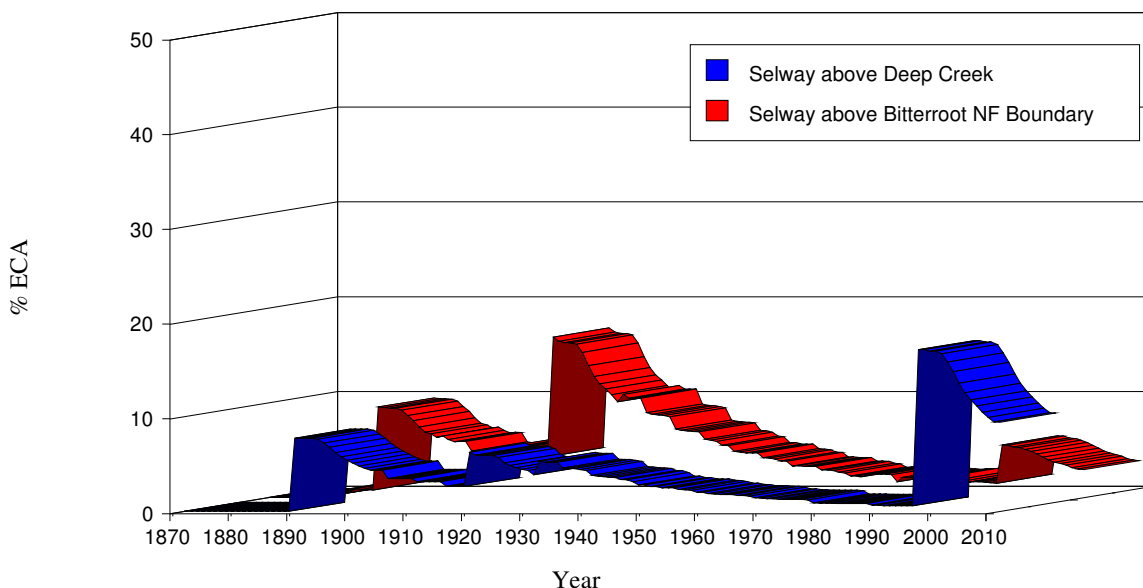
Cumulative Effects of Water Yield on the Selway River: The graphs in Figures 4.13 and 4.14 represent cumulative effects of water yield on the Selway subbasin, as modeled for four areas between the headwaters and the mouth of the mainstem Selway River. These areas are:

- Selway subbasin above Deep Creek
- Selway subbasin above the Bitterroot National Forest boundary
- Selway subbasin above the mouth of Meadow Creek
- The total Selway subbasin

Selway Above Deep Creek and Above the Bitterroot National Forest Boundary: Figure 4.13 represents the ECA for the upper Selway subbasin above Deep Creek, and above the Bitterroot National Forest boundary. Wildfire follows the patterns for ECA peaks for the historical fire years

of 1889, 1910, 1919 and 1934. ECA peaks from wildfires were smaller in the upper Selway subbasin above Deep Creek than below Deep Creek. This is because the watersheds are located at higher elevations closer to the Bitterroot Divide where the snowpack lasts longer. This pattern is representative of the upper Selway watersheds that have large portions of the watersheds in high elevations, resulting in historical fires that are less severe and smaller.

Figure 4.13: Percent Equivalent Clearcut Area: Selway Above Deep Creek and Above the Bitterroot National Forest Boundary



Peaks occurring in the Selway subbasin above Deep Creek were: 1889 at 7 percent, 1919 at 5 percent, and in the 1920s around 5 percent. The ECA dropped gradually until the early 1990s when the Swet Creek fire occurred. The ECA peaked at 15 percent at this point and is gradually decreasing. The fires that burned in the year 2000 are not shown on the graph above. A portion of Swet Creek burned again in 2000. Twenty-three percent of the Selway headwaters above Deep Creek burned with 5 percent high severity, 6 percent moderate severity, and 11 percent low severity.

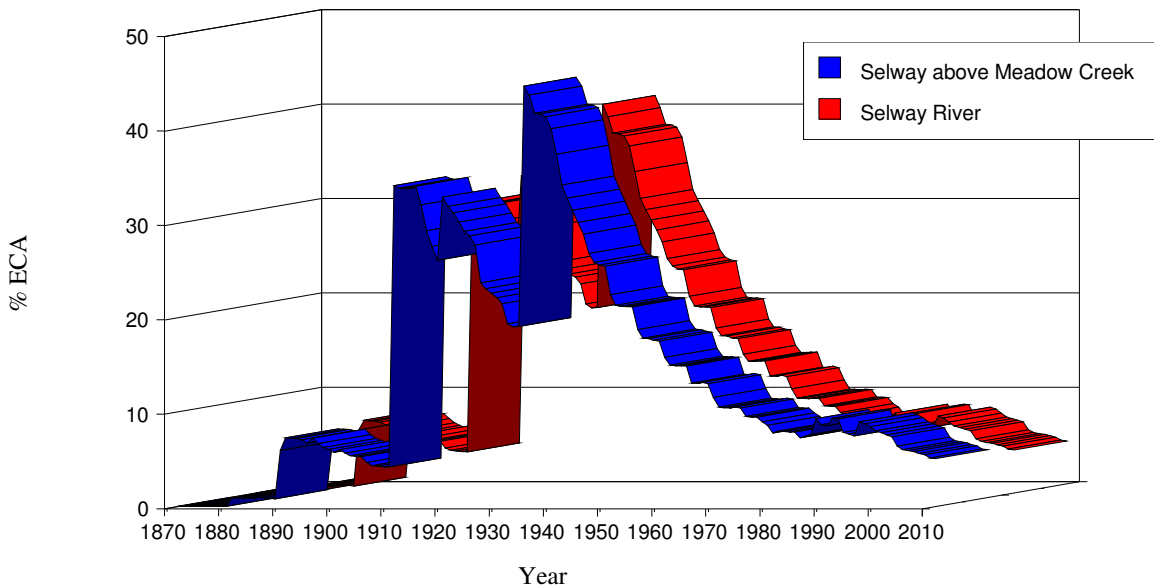
The ECA of the Selway subbasin above the Bitterroot National Forest boundary displays ECA peaks that are higher than the basin above Deep Creek. This follows the trends of the tributary watersheds. In general, tributaries that are located lower in the basin (lower elevation) tend to have higher ECA peaks, but the peaks occur on similar years. The highest peak is in the 1920s at 15 percent. This contributes to cumulative increase in the ECA peak. A small increase in ECA is shown for late 1990s due to the Swet Creek Fire. The graph for the Selway subbasin above the Bitterroot National Forest boundary is a larger area, so the effect of the Swet Creek Fire on ECA is diluted more than it is for the Selway subbasin above Deep Creek.

Selway Above Meadow Creek and Total Selway Subbasin: As can be seen in Figure 4.14, the ECA pattern for the Selway subbasin above Meadow Creek and the pattern for the total Selway subbasin are similar. The pattern shows that around 1910 the ECA above Meadow Creek, slightly over 30 percent, was due to wildfire. This was also true for the total subbasin acres. Around 1934, wildfire was responsible for an ECA of over 40 percent in the subbasin above Meadow Creek. This was also true for the total subbasin. This is an example of a large pulse disturbance in 1910 with gradual recovery between events, but with another large event occurring in 1934 on a subbasin-wide scale. The subbasin is adapted to the occurrence of and recovery from large pulse events. This is reflected in the vegetation in the Selway subbasin, which is dependent on and has

adapted to regenerate after fire, and some of which can withstand low intensity fire. Ponderosa pine, for example, has bark that is adapted to withstand fire.

The ECA has gradually decreased, as vegetation recovered between 1940 and 1980, and no large widespread fire events occurred. There is a slight increase in ECA percent on both curves in the early 1990s, probably due to the Swet Creek Fire. The effects of fire in the subbasin and the large size of the subbasin seem to mute the effects of timber harvest in the lower Selway subbasin below Meadow Creek. The ECA is elevated slightly in the 1990s and drops in the early 2000s. Both graphs seem to be similar during this period.

Figure 4.14: Percent Equivalent Clearcut Area: Selway Above Meadow Creek and Total Selway Subbasin



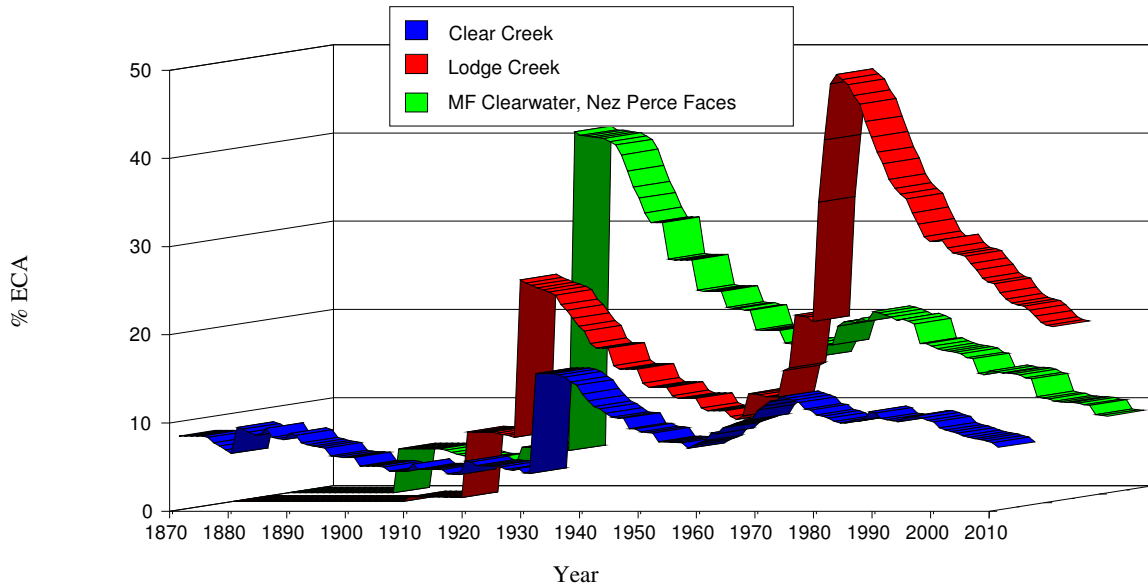
Lochsa Subbasin: The Lochsa River was not analyzed as part of the Selway and Middle Fork Clearwater subbasin assessment. Historical ECA from wildfire was not modeled for the Lochsa subbasin. But, because the Lochsa flows into the Middle Fork Clearwater River, it needs to be considered when considering water yield. The following discussion about some of the main tributaries of the Lochsa was written by Dick Jones, Forest Hydrologist for the Clearwater National Forest. The information is found in the draft *Hydrology and Water Quality Report for the Lochsa River Subbasin Analysis*.

Managed watersheds which are major tributaries of the Lochsa, such as Pete King Creek, Canyon Creek, Squaw Creek, and Papoose Creek, show a declining trend in streamflow and peak flow increases due to watershed recovery from past timber sales, and an increase in road obliteration. The watersheds were modeled in the WATBAL model, which estimates mean annual flow (Qa) and peak flow (Qp). Watersheds that historically had large wildfires, such as Wier, Old Man, Split and Fire Creeks show high water yield and peak flow increases after fire. From the WATBAL information for the Lochsa subbasin, Jones compiled a cumulative effects analysis for 68 percent of the Lochsa subbasin. From this information, he estimated that for the subbasin mean annual streamflow has increased 1.19 percent and peak flow has increased 1.24 percent. The increases were modeled in WATBAL using statistics from past road construction, timber harvest, and wildfire.

Middle Fork Clearwater Subbasin: Selected tributaries of the Middle Fork Clearwater subbasin are displayed on the following graphs that represent historic and current ECA trends, which represent water yield. Wildfire, road construction, and timber harvest effects are modeled. The

graphs show two distinct patterns. The first shows historical wildfires from 1870 to 1940. The second pattern illustrates a combination of fire, timber harvest and roads.

Figure 4.15: Percent Equivalent Clearcut Area: Clear Creek, Lodge Creek, and Middle Fork Clearwater River-Nez Perce Face Watersheds



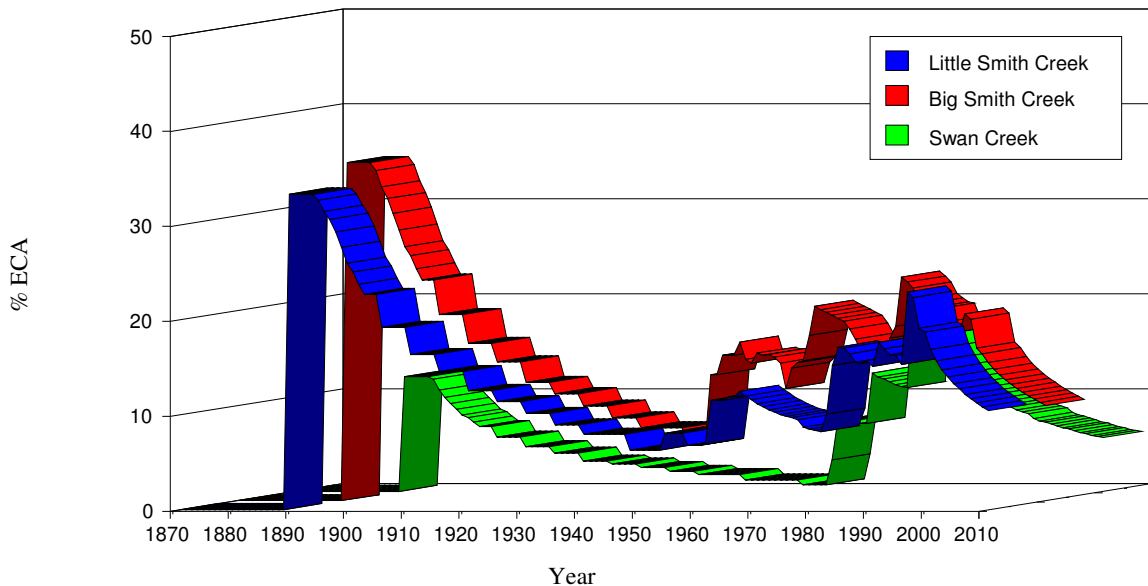
Clear Creek, Lodge Creek, and Middle Fork Clearwater River-Nez Perce Face Watersheds:

Figure 4.15 shows the ECA for the Middle Fork Clearwater River-Nez Perce face watersheds, Clear Creek watershed, and the watershed of a small sixth code HUC, Lodge Creek. All of these watersheds flow into the south side of the Middle Fork Clearwater River on the Nez Perce National Forest. ECA models the disturbance from wildfire in these watersheds starting at 1870. As in the roadless and wilderness watersheds, wildfire was the main disturbance in the 1940s. The Clear Creek watershed graph shows fire had a steady influence on ECA with an elevated level of ECA between 5 to 10 percent between 1870 and the 1930s. The highest peak in ECA for Clear Creek watershed is in the 10-year period between 1930 and 1940. The peak in ECA was 12 percent, with a gradual but steady decline until the 1950s, when the ECA dropped to 7 percent. At this point timber harvest and road construction started, and ECA peaked again at about 11 percent in the 1970s. ECA in Clear Creek watershed is dropping gradually, but never decreases below 6 percent. The graph does not break out the contribution from wildfire after 1950. The current ECA is mainly a result of timber harvest and road construction, but some percent may also be due to fire effects.

Lodge Creek is a small sixth code HUC watershed with steep headwater and mainstream channels. Lodge Creek watershed ECA peaked around 1910 to 1920 at about 7 percent, around 1920 to 1930 at about 23 percent, and in the 1970s at 46 percent. The first two peaks were due to wildfire, with a gradual drop in ECA after 1930 to 8 percent, but with a sharp increase in the 1970s due to intense logging activity in the headwaters. Between 1970 and the current time, the ECA has recovered to 18 percent. Most of this residual ECA is due to logging and road construction. The Middle Fork Clearwater River-Nez Perce face watersheds peaked at 40 percent due to wildfire around the 10 year period from 1930 to 1940, then dropped to 16 percent by 1960, and gradually increased with the onset of logging and road construction to 20 percent. The current ECA is 10 percent, and is mostly due to harvest and compacted skid trails and roads.

In the case of Lodge Creek watershed, the peak from timber harvest and roads exceeds the peaks from wildfire. In Clear Creek watershed and the Middle Fork Clearwater River-Nez Perce face watersheds, the 1934 wildfire peak exceeds the peak from management activities.

Figure 4.16: Percent Equivalent Clearcut Area: Little Smith Creek, Big Smith Creek, and Swan Creek Watersheds



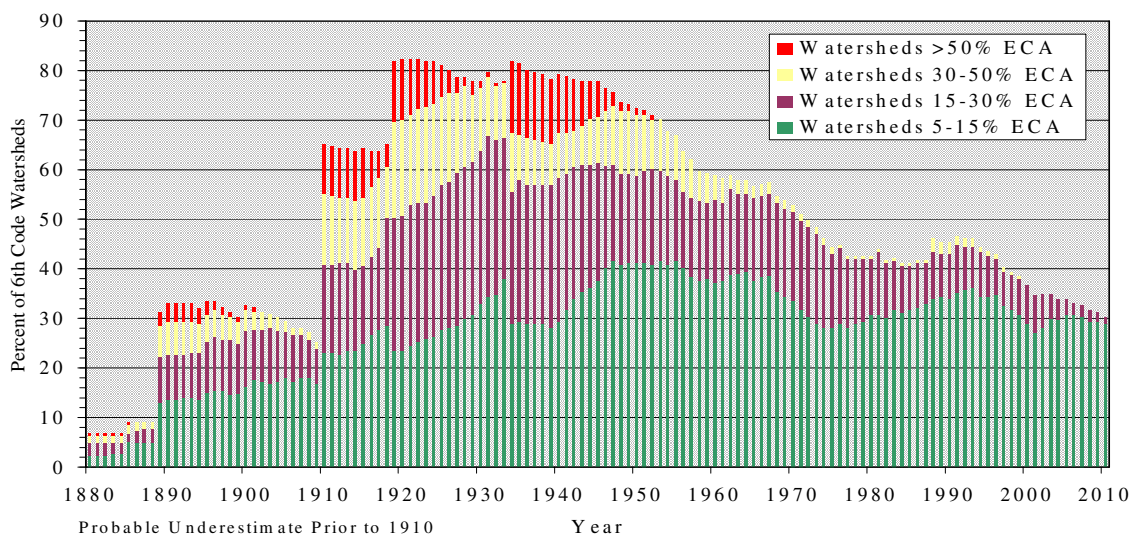
Little Smith Creek, Big Smith Creek, and Swan Creek Watersheds: Figure 4.16 shows the overall ECA for three Middle Fork Clearwater subbasin watersheds in the Clearwater National Forest. The highest ECAs in Big Smith Creek and Little Smith Creek watersheds were 35 to 40 percent in the period from 1910 to 1920. Swan Creek watershed had a peak ECA of 12 percent around the same period. The ECA in all three watersheds decreased gradually to the mid-1940s to 1950s. The ECA peaks from historic fires were higher than the peaks due to management activities. The ECA peaks from fire recovered gradually, but recurrent harvest and road building in these three watersheds has not allowed recovery in the watersheds. After 1960, timber harvest and road construction contributed to an increase in ECA for Big Smith Creek watershed to a high of 22 percent, Little Smith Creek watershed peaked also around 22 percent, and Swan Creek watershed ECA increased with timber harvest and road construction up to around 15 to 20 percent. Currently all three watersheds are around 15 to 20 percent ECA.

Water Yield Trends for the Middle Fork Clearwater Subbasin Watersheds: Two patterns are displayed in the curves in Figures 4.15 and 4.16. The first is due to historic wildfire. The ECA peaks for wildfire increase very quickly and recover steadily over a period of years. This is a common pattern for pulse disturbances such as wildfire. Water yields increased and streamflow regimes changed after wildfire in conjunction with increase in sediment. This had a large effect on channel forming processes such as scour, aggradation, deposition and wood recruitment. The pattern due to management activities shows several ECA peaks occurring within a short time with very little recovery between timber harvest and road construction entries. This initiates press disturbances with large departures from the historic disturbance patterns.

Stream channels evolved with sediment regimes and water yields tied to large pulse disturbances. The effects of long-term chronic sediment and increased water yield over prolonged periods, such as the past 40 years of management, are not fully known. The balance of water yield and sediment input into the system is definitely altered under the management regime.

Historic fire peaks follow the same patterns from 1870 to 1935 as in the watersheds in the lower Selway subbasin. Fire was the dominant disturbance on the landscape historically. If management activities had not occurred after 1940, recovery patterns would mimic the lower Selway unmanaged watersheds, with recovery to almost 0 percent ECA for the year 2000, unless fire recurred.

Figure 4.17: Frequency Of Equivalent Clearcut Area (ECA) Condition In Sixth Code Watersheds in the Selway and Middle Fork Clearwater Subbasins



Frequency of ECA Condition in Sixth Code Watersheds in the Selway and Middle Fork Clearwater Subbasins: Figure 4.17 displays the percent of sixth code watersheds in each of four categories of ECA. It shows how the spatial extent and timing of ECA have varied with wildfires and timber harvest. The effects of the wildfires of 1889, 1910, 1919 and 1935 are clearly visible. Since then, the percent of watersheds in the higher ECA categories has decreased dramatically. Timber harvest beginning in the 1950s has tended to maintain the overall percentage of watersheds in the 5 to 15 percent ECA and to a lesser extent, in the 15 to 30 percent ECA categories. However, the percentage of watersheds in the 30 to 50 percent and the >50 percent ECA categories has decreased to zero. It should be noted that ECA prior to 1910 is probably underestimated, since no fire history data are available prior to 1870. Thus, the residual effects of fires prior to that date are not accounted for.

Sediment Yield

The erosion of the landscape yields sediment (solid fragments of organic or inorganic material) to streams. Sediment yield refers to the movement of sediment through the stream channel system. Sediment yield is typically expressed as tons per year or percent over base (synonymous with percent over natural). The morphology of stream channels (width, depth, slope, substrate, etc.) is the result of the balance between the timing and amount of water yield and the amount of sediment yield, deposition, and transport.

Sediment yield is an important indicator of watershed condition since it integrates the effects of upslope and in-channel conditions. It has a direct link to fish habitat quality as well as to other beneficial uses of water. Sediment yield is related to turbidity and often has a high correlation to fine sediment deposited in stream substrate. If changes occur in the amount of sediment or magnitude of peak flows, the shift in the balance between water yield and sediment yield can lead to changes in channel morphology. For instance, an increase in water yield without an increase in sediment yield may lead to scouring the stream bed and the channel down-cutting, and conversely, increases in sediment yield without an increase in water yield can lead to excessive deposition of sediment in the stream channel. The stream system is a connected network, and therefore changes in the physical processes upstream have effects in downstream reaches.

Sediment Analysis Methods: Sediment yield can be sampled in the field by a variety of methods. Most commonly, samples are taken for suspended sediment, bedload (sediment

moving in or near a stream bed), and stream discharge. Another method uses sediment detention basins. Sediment yield can also be modeled using one of several approaches. For this analysis, sediment yield was modeled using NEZSED, a computer model tiered to a set of guidelines developed by hydrologists and soil scientists from the Intermountain Research Station and the Forest Service Northern and Intermountain Regions (USDA Forest Service, 1981).

From the guidelines that were developed and referred to above, specialists at the Nez Perce National Forest produced the NEZSED model. This model estimates the average annual natural or base rate of sediment yield and surface erosion sediment yield produced from roads, logging, and fire. The model is limited in that it does not consider the effects of activities on mass erosion greater than 10 cubic yards or the effects of grazing on stream bank erosion. Though the model shows annual variations in response to land use, it does not attempt to estimate annual variation due to climate or weather events.

Sediment yield for the Clearwater National Forest lands north of the Middle Fork Clearwater River were modeled using WATBAL. WATBAL models surface sediment yield using similar guidelines as NEZSED, based on the guidelines discussed above. WATBAL also models mass wasting erosional processes developed on the Clearwater National Forest using landslide data derived from the Clearwater National Forest and research watersheds in the Idaho Batholith. The upper Selway subbasin portion of this assessment located within the Bitterroot National Forest was modeled using hand calculations for percent sediment over base using the Forest Service Northern and Intermountain Region's sediment methodology. Main sediment sources in these watersheds were Selway River access roads and historic wildfires.

Sediment Yield in the Selway and Middle Fork Clearwater Subbasins: Historically, in the Selway and Middle Fork Clearwater subbasins, the main disturbances were pulse disturbances such as fires and floods. In general the pulse of sediment from wildfire or flood events shows sediment increases, with recovery in a few years. In the wilderness and roadless watersheds, this process has been somewhat affected by fire suppression since 1930. In general, the fires that occurred between 1880 and 1934, mainly the four largest fire years of 1889, 1910, 1919 and 1934, show quick pulses of sediment ranging from 10 to 60 percent, and recovery in a few years. These sediment pulses from fire were interspersed with floods that occurred in 10 to 15 year intervals, often resulting in pulses of sediment from landslides and debris torrents. These events occurred if floods followed soon after wildfire.

In the lower Selway subbasin below the wilderness boundary, the Middle Fork Clearwater subbasin, and a few watersheds with roads that access wilderness trailheads such as Deep Creek, roads and timber harvest have been a source of wide-scale press disturbance resulting in sediment regimes that have affected aquatic integrity, mostly in tributary streams. Sediment modeling based on road construction and reconstruction activities, beginning as early as 1930 in some tributary streams such as Deep Creek, shows that the effect of increasing sediment levels above the natural base levels was virtually continuous from 1930 until 2000.

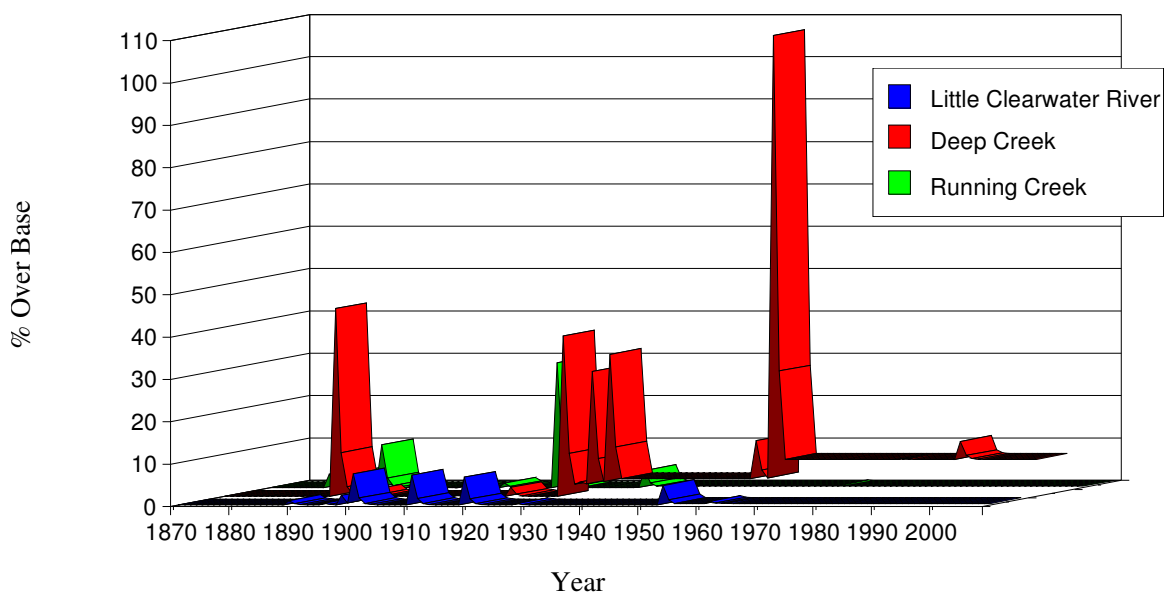
For this analysis, sediment yield was modeled for the period 1870 through 2010. The disturbance history before 1870, mainly wildfire, was not modeled for sediment yield, so percent sediment over base before 1870 is unknown. Since sediment from fire recovers within 5 years when modeled in NEZSED, this is only a concern for the years 1865 to 1870. For the wilderness and roadless areas of the Selway subbasin, wildfire is the main disturbance that is modeled, except for some access roads, such as the road along Deep Creek. The sediment analysis for the wilderness includes natural baseline plus sediment from historic and current wildfires. From 1940 through 2010 in the lower Selway subbasin and the Middle Fork Clearwater subbasin, human activities such as timber harvest and road construction started to occur and are projected to continue. Timber harvest and road effects, combined with wildfire effects, are modeled for this period. Of these effects, the model suggests sediment recovery from wildfire after 5 years and

recovery from timber harvest after 7 years. The model predicts a continuing sediment production from roads as long as they remain on the landscape.

The sediment modeling for the Selway and Middle Fork Clearwater subbasins does not include the effects of activity-induced mass erosion, except where WATBAL was used on the Clearwater National Forest portion of the Middle Fork Clearwater subbasin. Road effects are probably underestimated during the period from 1940 through about 1980 because sediment mitigation measures were not as refined during that period, but technical limitations of the model would have made it very difficult to account for this difference. Thus, roads built during this period were modeled with their current mitigation values, rather than those that would have been in place when initially constructed.

Selway Subbasin Tributary Watersheds: Following are graphs that show modeled sediment for tributary watersheds of the Selway River and sediment yield for modeled reaches of the mainstem.

Figure 4.18: Percent Over Base Sediment Yield: Little Clearwater River, Deep Creek, and Running Creek Watersheds



Little Clearwater River, Deep Creek, and Running Creek Watersheds: Figure 4.18 shows percent over base sediment yield for the Little Clearwater River, Deep Creek, and Running Creek watersheds. About 30 percent of the headwaters of the Deep Creek watershed burned in a wildfire around 1880 to 1890, with a peak of 41 percent over base sediment yield. There were several sediment peaks from wildfire and construction of the road from Elk City to Darby between 1920 and 1935. The highest peak at 33 percent is from the construction of the road along Deep Creek between 1928 and 1933; the second peak is around 1933 when the road was reconstructed. The construction of Hells Half-Acre Road around 1933 to 1939 also contributed to sediment peaks in Deep Creek watershed. The peaks from wildfire drop to 5 percent within 5 years, tending to be a pulse disturbance with a quick recovery. The next large peak shown due to reconstruction and widening of the road along Deep Creek is 108 percent over base. This tends to be a press disturbance resulting in long-term chronic sediment levels.

Road 468 to Magruder follows Deep Creek for 14 miles, often encroaching upon or occupying part of the original stream course. Along much of the 14 miles there are no buffer strips of vegetation between the road and the stream, so sediment delivery is directly into the stream. Rehabilitation of the road sediment sources was planned along Deep Creek in 2001. Chronic

sediment is shown for Deep Creek watershed at around 8 percent continuing on into 2000, due to continuing effect from the road along with a smaller residual effect from past wildfire. Sediment yields from fire tend to recover relatively quickly, but road systems, especially directly next to streams, continue to produce sediment for long periods. The Selway Road Sediment Stabilization Project of 2001 should help reduce chronic sediment.

Running Creek watershed has a similar fire history to other upper Selway subbasin watersheds. A sediment peak of 10 percent is shown in 1889, and a peak of 29 percent in 1919, followed by quick recovery. A peak of 4 percent over base in 1934 is shown on the graph when the road along Running Creek was constructed. Sediment dropped to <1 percent within a few years and remains there until the year 2000. One percent of Running Creek watershed burned in the year 2000.

The Little Clearwater River watershed shows small peaks in sediment yield of 4 to 7 percent in 1889, 1900, 1910 and 1919, which is similar to the fire history of the watersheds in the upper Selway subbasin. The sediment decreases within a couple of years to <1 percent for all four fire years. Around 1953, a road was constructed that follows the ridge at the headwaters of the watershed, creating a sediment peak of 4 percent over base, with a decrease to <1 percent in a few years. In the year 2000, 38 percent of the Little Clearwater River watershed burned. Sediment peaks for the 2000 fires are not shown on the sediment graphs. In the watershed of Flat Creek, a tributary of the Little Clearwater River, the modeled projected sediment peak for spring 2001 is as high as 30 percent. This does not represent the total watershed, but is an example of the projected spring 2001 sediment peak. The overall Little Clearwater watershed will have a lower peak. Flat Creek watershed had the most area burned with high and moderate severities, so it has the highest projected sediment peak.

White Cap and Bear Creek Watersheds: Figure 4.19 displays sediment yield in percent over base for White Cap Creek and Bear Creek watersheds. Patterns displayed on the graph show frequent small peaks from fire from 1870 to 1935. The sediment peaks show a distinct pattern that differs from watersheds located geographically lower in the Selway subbasin. Watersheds in the lower subbasin with longer snow-free seasons show similar, but higher sediment peaks from fire. White Cap Creek and Bear Creek watersheds show three sediment peaks from wildfires that occurred from 1880 to 1935. All of the sediment peaks are under 10 percent.

The fire occurrence from the period 1870 to 1935 is similar to other watersheds in the upper Selway subbasin. Fires are less severe, more frequent, and smaller in lower elevation, dryer parts of these watersheds. Similar patterns are displayed for more recent fires that have occurred from 1970 to the 1990s. Recovery from fire in White Cap Creek and Bear Creek watersheds has been fairly rapid, and the absence of human disturbance has allowed the watersheds to return rapidly to one percent over base.

Three Links Creek and Gedney Creek Watersheds: Figure 4.20 shows percent over base sediment yield for Gedney Creek and Three Links Creek watersheds. The sediment patterns show large pulse disturbances caused by wildfire with large sediment peaks. These watersheds are in the middle lower Selway subbasin. Although the headwaters of these watersheds are high elevation, large portions of the lower watersheds are snow-free longer and occur on lower elevation breaklands. Fires occur earlier, are higher in severity and intensity, and encompass more of the watershed, producing higher sediment peaks.

Figure 4.19: Percent over Base Sediment Yield: White Cap Creek and Bear Creek Watersheds

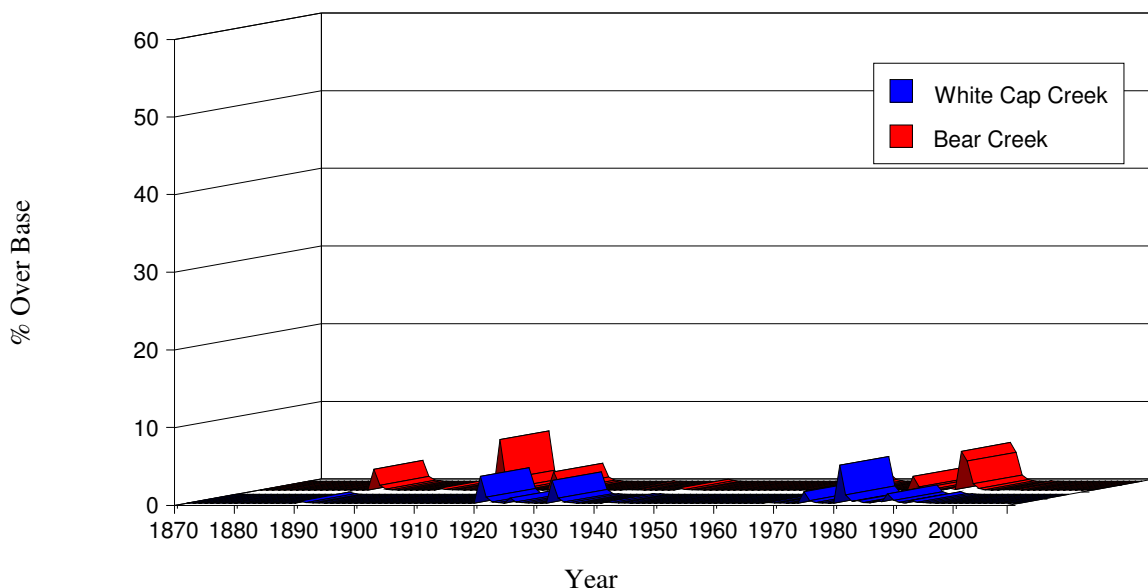
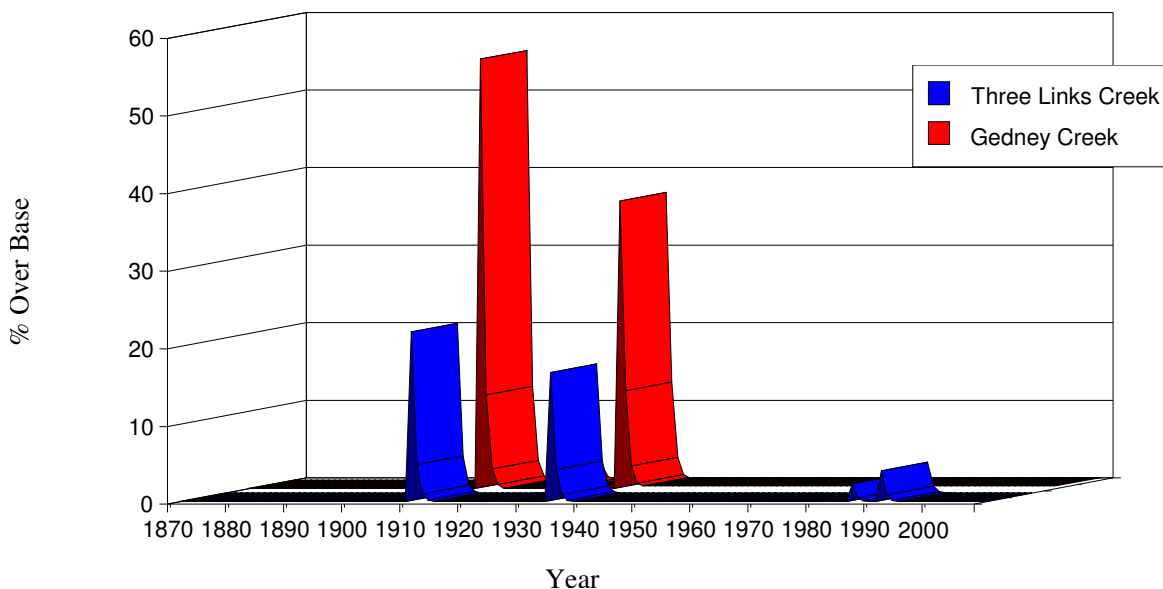


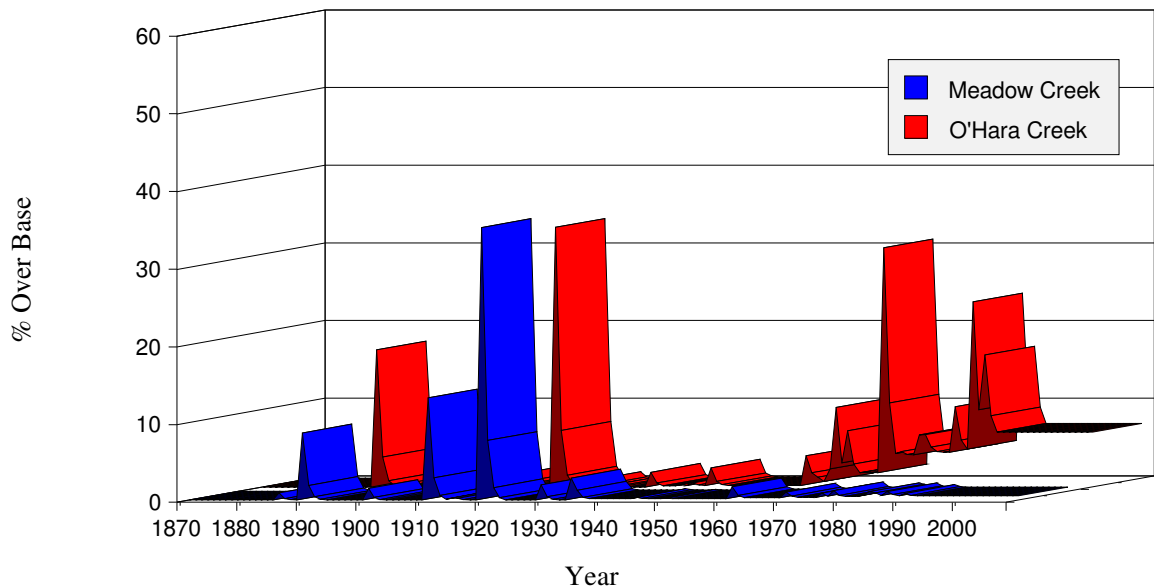
Figure 4.20: Percent Over Base Sediment Yield: Three Links Creek and Gedney Creek Watersheds



The two largest historical wildfire years for Three Links Creek and Gedney Creek watersheds are 1910 and 1934. The 1910 fire burned around 80 percent of the Gedney Creek watershed with a percent over base sediment peak of 55 percent. Around 50 percent of the Three Links Creek watershed burned with a percent over base sediment peak of 22 percent. The next large fire cycle for the Gedney Creek and Three Links Creek watersheds occurred in 1934. The 1934 fire burned over 50 percent of Gedney Creek watershed, with a peak of 37 percent over base sediment, and around one-third of the Three Links Creek watershed burned, with a peak of 16 percent over base sediment. After each wildfire, percent over base sediment decreased to <1 percent within four years.

Although sediment from mass wasting is not shown on the sediment graph or calculated in NEZSED, floods that occur as heavy rain, such as in 1964, resulted in large debris torrents coming down Gedney Creek and possibly Three Links Creek. The debris torrents supplied large amounts of wood and sediment to Gedney Creek and the main Selway River. From around 1940 to the present, the sediment peaks resulting from fire have decreased and large pulse events have not occurred. This is a common trend in the wilderness and roadless watersheds. This is mainly due to fire suppression.

Figure 4.21: Percent Over Base Sediment Yield: Meadow Creek and O'Hara Creek Watersheds



Meadow Creek and O'Hara Creek Watersheds: Meadow Creek and O'Hara Creek watersheds both show similar sediment peaks from wildfire in three of the four large historic fire years. O'Hara Creek watershed had a peak of 18 percent in 1889, and Meadow Creek watershed had a peak of 9 percent. Meadow Creek watershed has a sediment peak of 13 percent in 1910 from wildfire, and Meadow Creek and O'Hara Creek watersheds have large peaks of 35 and 33 percent from the 1919 wildfires. Both watersheds show a rapid recovery from wildfire, and peaks of <3 percent until development of roads and timber harvest began around 1960. The Horse Creek watershed experienced some timber harvest and road building in the late 1970s up until the early 1990s. The Meadow Creek watershed is so large that the activity peaks from the Horse Creek development do not have a large effect on the sediment peaks for Meadow Creek.

The development-related pattern for O'Hara Creek watershed shown in Figure 4.21 starts around 1960. The development of roads and timber harvest in O'Hara Creek watershed results in sediment peaks that are similar to the wildfire peaks, but recovery to sediment base levels does not occur, and chronic long-term sediment remains in O'Hara Creek watershed, mainly from roads, until the present time. When the curves for Meadow Creek watershed and O'Hara Creek watershed are compared from 1960 to 2000, the pattern of quick recovery of sediment to base level from wildfire in Meadow Creek watershed can be seen, and the chronic sediment interspersed with peaks from timber harvest and roads in O'Hara Creek watershed is apparent. This is a good comparison of pulse versus press disturbance between the two watersheds. The sediment level shown for O'Hara Creek watershed for the year 2000 is still 8 percent over base. Between 1996 and 2000, 20 miles of the 100 total miles of road in the O'Hara Creek watershed were obliterated. The effect of this road obliteration will be a small peak in sediment the first year, but over time road obliteration will result in a large decrease in chronic sediment source in the watershed.

Sediment Trends For The Selway Tributary Watersheds: The Selway subbasin historically was dominated by pulse disturbances such as wildfire and floods. The cycle that is evaluated in the sediment analysis only looks at a small point in geologic time from 1870 to 2010. During this time most of the basin had a history of several large fire years between 1880 and 1935. The severity and extent of the fires in the tributary watersheds varied due to elevation, landform, aspect, moisture regimes, and distance from the mouth of the Selway River, along with vegetation types. Press disturbances that produced long-term chronic sediment levels in some tributary streams started as early as 1930 with road construction in the Deep Creek watershed.

When comparing the watersheds in the upper Selway subbasin and the Little Clearwater River, Deep Creek, and Running Creek watersheds, two trends are apparent. First, the pattern of sediment peaks before 1930 is caused by wildfire, and quick recovery occurs in the Little Clearwater and Running Creek watersheds. Second, a pattern is shown for Deep Creek watershed, with chronic levels of sediment still remaining in 2000 due to the road along Deep Creek and dating from the time of its first construction in 1930.

Sediment patterns in watersheds with more high elevation area and snow retained late into the year show peaks that vary from those of the watersheds in the middle and lower Selway subbasin. The sediment peaks recur almost as often, but are smaller than the peaks in watersheds lower in the subbasin. Peaks are smaller because of higher soil moisture later in the year, which in turn is related to shorter fire seasons. Historically, fires in watersheds such as White Cap and Bear Creeks had less severity and intensity and were smaller in area on a watershed scale. Note: The sediment peaks in the smaller watersheds are somewhat amplified by the NEZSED model and may be somewhat higher than real peaks, where in larger watersheds such as White Cap and Bear Creeks, the peaks are not amplified.

Sediment patterns in watersheds that are lower on the Selway River such as Gedney and Three Links Creeks have high sediment peaks. These watersheds have large areas that are snow-free early in the fire season, and are located on warm aspects. The fire season is longer and fires are more severe and intense, and encompass large numbers of acres in the watersheds. This type of fire season and fire is common in the lower Selway watersheds. This pattern represents the watersheds on the North Selway face that have some roads, but low road densities and minimal timber harvest.

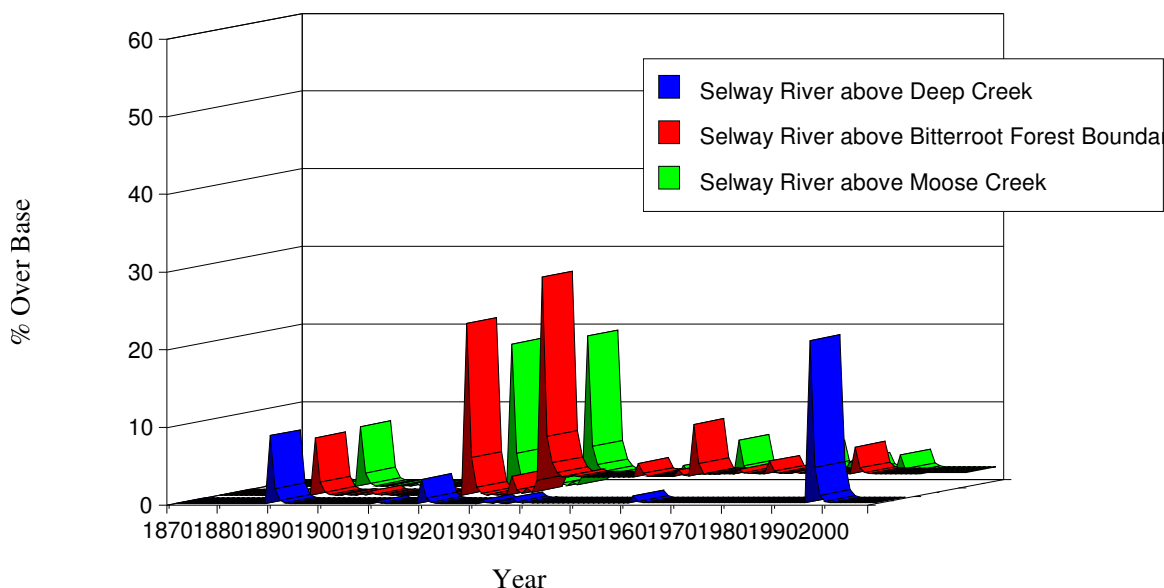
The comparison of Meadow Creek and O'Hara Creek watersheds represents two patterns. Up to the early 1960s, similar peaks are shown for wildfire disturbance. Fires were large around 1920, with quick recoveries in the watersheds. The pattern changes around 1960, when timber harvest and road construction started in O'Hara Creek watershed. The pattern in O'Hara Creek watershed shows the change from pulse to press disturbances with the introduction of roads and timber harvest in the 1960s. The loss of pulse disturbance due to fire suppression is also apparent for both O'Hara Creek and Meadow Creek watersheds after the 1940s. The pattern in O'Hara Creek watershed represents the managed lower Selway watersheds on the south Selway face that have common histories of road construction and timber harvest.

Stream channels evolved with sediment regimes and water yields tied to large pulse disturbances. The effects of long-term chronic sediment and increased water yield over prolonged periods, such as the past 40 years of forest management, is not fully known. The balance of water yield and sediment input into the system is definitely altered under the management regime.

Cumulative Effects Of Sediment On The Selway Subbasin: The graphs in Figures 4.22 and 4.23 represent the cumulative effects of sediment on the Selway subbasin. The mainstem Selway was modeled at five points between the headwaters and the mouth. These points were the Selway subbasin above Deep Creek, the Selway subbasin above the Bitterroot National Forest

boundary, the Selway subbasin above the mouth of Moose Creek, the Selway subbasin above the mouth of Meadow Creek, and the total Selway subbasin.

Figure 4.22: Percent Over Base Sediment Yield: Portions of the Upper Selway River Above Deep Creek, Above the Bitterroot National Forest Boundary, and Above Moose Creek



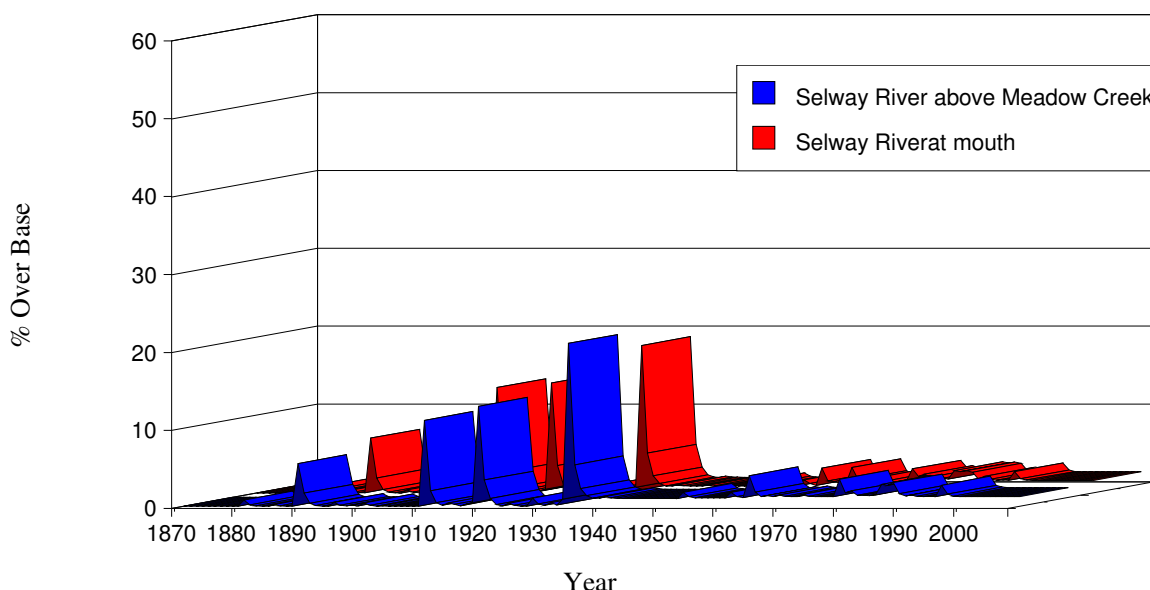
Portions of the Upper Selway River Above Deep Creek, Above the Bitterroot National Forest Boundary, and Above Moose Creek: Figure 4.22 displays sediment yield for the mainstem Selway River with three reach breaks used for sediment modeling. The reach breaks for sediment modeling are the Selway subbasin above Deep Creek, the Selway subbasin above the Bitterroot National Forest boundary, and the Selway subbasin above the confluence with Moose Creek. Sediment peaks of 7 to 8 percent are displayed for all three reaches for the historic fire year of 1889, with a recovery close to 0 percent over base sediment yield within three years. The Selway River above Deep Creek shows several small peaks of less than 3 percent between 1920 and 1996. In 1996, the Swet Creek fire occurred, with a sediment peak of 21 percent over base sediment generated from the 40,000-acre fire. In 1997, after a heavy thunderstorm Swet Creek ran black with ash; this was observed during a monitoring trip. Discoloration in the upper Selway River in 1997 and 1998 was probably a result of mass wasting that was still occurring, or sediment and ash picked up in high spring runoff on Swet Creek. Discoloration in the river has been traced from the upper Selway to below Moose Creek. Portions of Swet Creek watershed burned again in 2000, and 23 percent of the area around the Selway headwaters above Deep Creek burned. Sediment peaks from the 2000 fires are not shown on the graph. The 5 percent high severity burn combined with the 6 percent moderate severity burn would probably produce a small sediment peak in the year 2001.

The Selway River above the Bitterroot National Forest boundary shows a sediment peak of 22 percent from historic wildfire, with a recovery to almost 0 percent over base sediment in a few years. In 1934, road construction resulted in a sediment peak of 28 percent. Over time, the sediment peak dropped to <5 percent, but remained at that level over a long period of time. There was another peak of sediment again in 1964 when the road was reconstructed, and some small peaks from wildfire. Currently, percent over base sediment is around 3 percent, most likely chronic sediment from the road, and possibly some residual sediment from wildfire.

Almost the same pattern in sediment peaks is observed for the reach above Moose Creek as for the reach above the Bitterroot National Forest Boundary. The fire history is similar, with sediment peaks showing rapid recovery. Sediment peaks from the construction and reconstruction of Road

468 along Deep Creek and Road 6223 along the Selway River to Paradise produce similar sediment peaks to those of the other reach, but the peaks are not as high. This is because sediment effect from the road is somewhat muted due to the larger subbasin size above Moose Creek. The sediment recovery is still somewhat elevated, around 2 percent currently.

Figure 4.23: Percent Over Base Sediment Yield: Selway River Above Meadow Creek, and Total Selway River

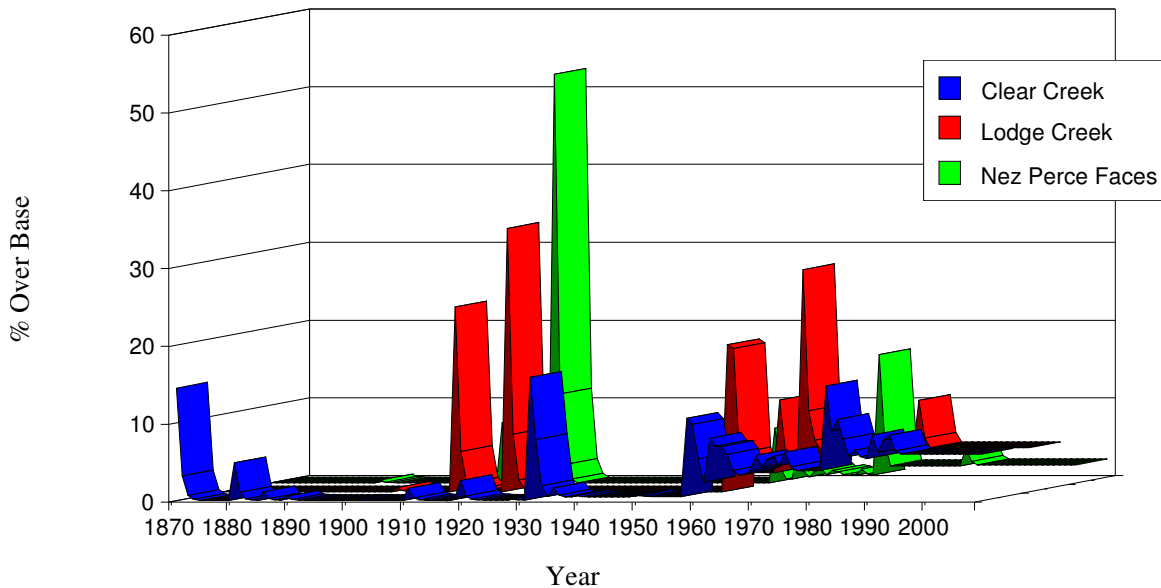


Selway River Above Meadow Creek, and Total Selway River: Figure 4.23 displays the Selway subbasin above Meadow Creek, compared to the entire Selway subbasin. The history of fire displayed is similar when looking at the subbasin above Meadow Creek, and then including the rest of the subbasin below Meadow Creek. The four large historic fire years are all represented starting in 1889, with a peak of 5 percent for the Selway subbasin above Meadow Creek, and a peak of 6 percent when the total Selway subbasin is included. The pattern follows for 1910, with peaks of 11 percent and 13 percent; 1919 with peaks of 13 percent and 14 percent; and 1934 with peaks of 18 percent and 20 percent. Only 2 percent of the sediment peak was generated in the Selway subbasin below Meadow Creek.

Selway River Sediment Yield Summary: The four historic fire years stand out as showing the highest sediment peaks that represent the largest pulse disturbances during this time period. The pattern shows almost full recovery to 0 percent sediment yield over base between each sediment peak. After 1934, when roads were constructed along Deep Creek and along the Selway River to Paradise, 1 to 3 percent of sediment yield is always present until the year 2000. The roads and timber harvest below Meadow Creek probably contribute to this also, along with some wildfire. When comparing the sediment curves for the subbasin above Meadow Creek and the total subbasin between 1935 and 2000, little difference is observed. The effects of the timber harvest and road construction in the watersheds below Meadow Creek are probably muted by the size of the subbasin, so the peaks are similar.

Middle Fork Clearwater Subbasin Tributary Watersheds: Historic sediment trends for selected watersheds of the Middle Fork Clearwater subbasin are displayed in Figures 4.24 and 4.25. Wildfire, road construction, and timber harvest effect were modeled for surface sediment with the NEZSED model on the south side of the river in the Nez Perce National Forest. Watersheds on the north side of the river in the Clearwater National Forest were modeled for the same activities, but surface and mass wasting effects were both modeled using the WATBAL model.

Figure 4.24: Percent Over Base Sediment Yield: Clear Creek, Lodge Creek, and Middle Fork Clearwater River-Nez Perce Face Watersheds

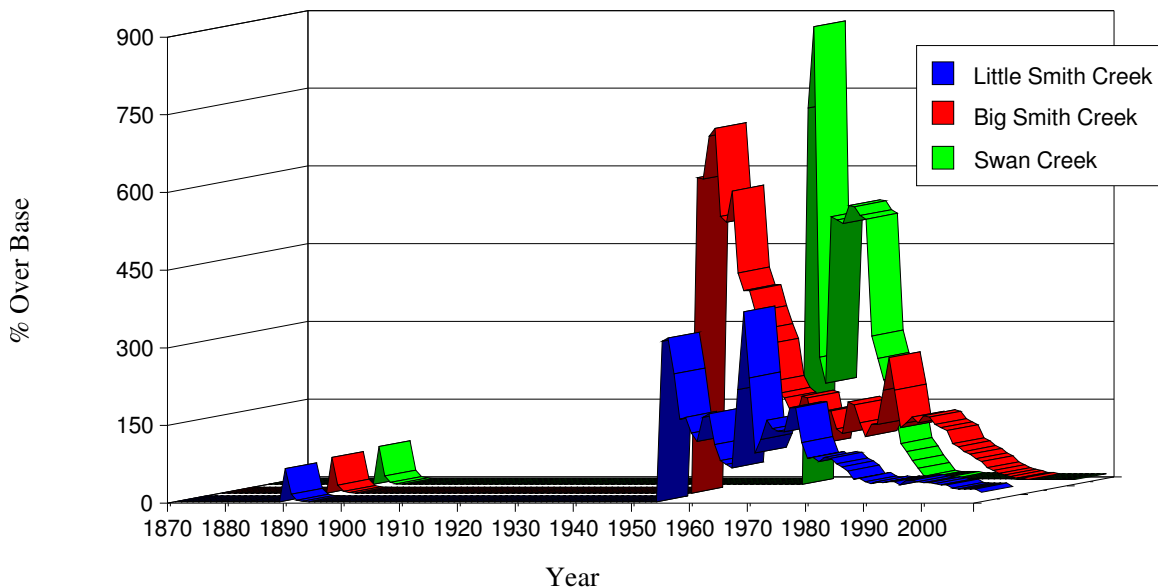


Clear Creek, Lodge Creek, and Middle Fork Clearwater-Nez Perce Face Watersheds: Figure 4.24 displays the sediment peaks for Clear Creek, Lodge Creek, and the Middle Fork Clearwater River-Nez Perce face watersheds from 1870 to 2000. These watersheds show relatively large sediment peaks in 1910, 1919, and in the early 1930s in response to wildfires. Recovery from these peaks was fairly rapid, as shown by the drop to almost 0 percent sediment yield by all three watersheds in 1940. The sediment yield patterns between 1962 and 1990 are similar for all three watersheds, although the magnitude of the peaks varies by watershed. This pattern is representative of press disturbances in all three of the watersheds. The peaks in Lodge Creek watershed may be somewhat amplified due to the small size of the watershed.

The increase in press disturbance in the watersheds due to managed activities is similar to watersheds south of the lower Selway River. Chronic sediment yield has been progressively increasing since road construction began in 1962, and continues at the present time. Sediment above base level is still around 6 percent as shown for all three watersheds.

The fire peaks (1910 to 1934) are slightly higher for all three watersheds than the peaks from human development (1962 to 1990). The important trend to note is that the sediment after fire recovers quickly to natural base levels and chronic sediment remains as long as roads are contributing sediment in the watershed.

Figure 4.25: Percent Over Base Sediment Yield: Surface and Mass Erosion; Little Smith Creek, Big Smith Creek, and Swan Creek Watersheds



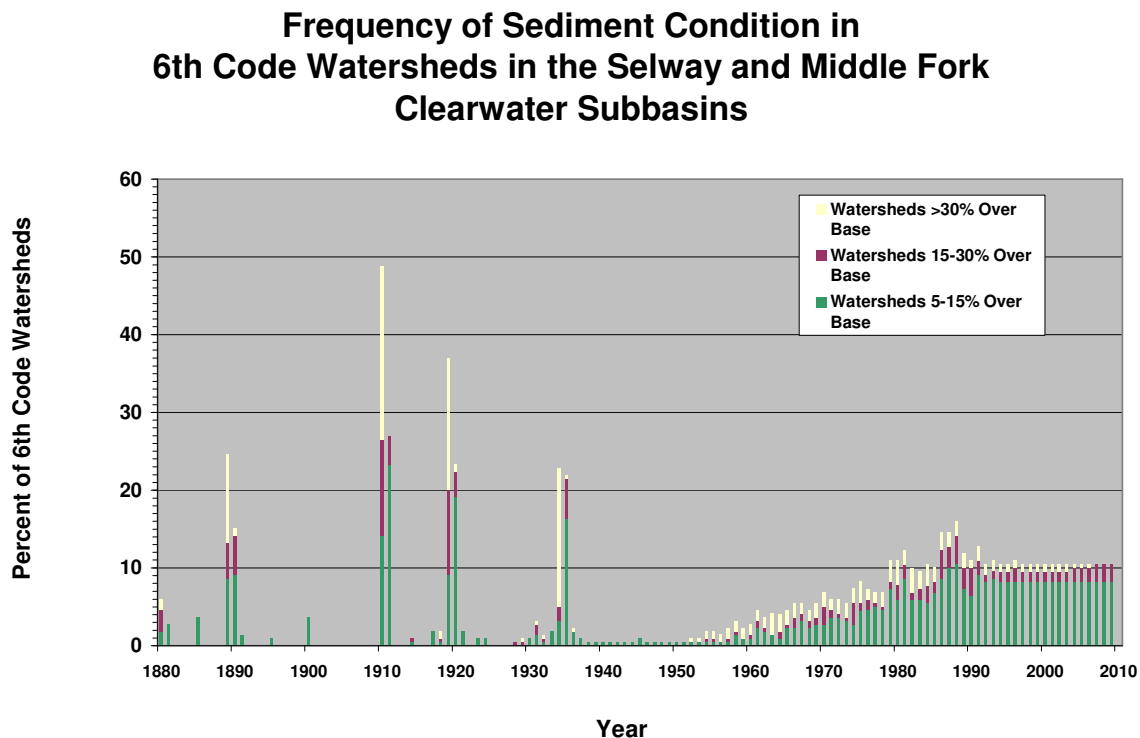
Little Smith Creek, Big Smith Creek, and Swan Creek Watersheds: Sediment yield and percent over base sediment shown in Figure 4.25 for Big Smith Creek, Little Smith Creek, and Swan Creek watersheds were modeled in the WATBAL model, which is used in the Clearwater National Forest. The base sediment is much higher than watersheds modeled in the NEZSED model. The WATBAL model includes mass wasting sediment plus surface sediment; the NEZSED model includes only surface sediment, and this difference results in a much higher percent over base sediment modeled by WATBAL. WATBAL models mass wasting erosional processes; it was developed by specialists at the Clearwater National Forest using landslide data derived from the Clearwater National Forest and research watersheds in the Idaho Batholith. Small sediment peaks from wildfire around 1910 in Big Smith Creek watershed quickly returned to base sediment levels. A second pattern is shown around the mid 1950s, when road building and timber harvest started in Big Smith Creek watershed, with the peak activity in 1955. The sediment peak for surface plus mass erosion was around 703 percent. There were several smaller sediment peaks from 1960 to 2000, with a gradual downward trend. In 1995 and 1996, a winter rain-on-snow storm caused several failures on roads and in clearcuts in Big Smith Creek watershed. This short-term, intense event was not modeled with the sediment model. Currently, percent sediment over base is 66 percent and is probably due to long-term chronic sediment from roads.

Road construction and logging activity started in Little Smith Creek watershed around 1954, with a peak for surface plus mass erosion of 256 percent over base sediment. Timber harvest and intermittent road construction continued from 1954 to 1970, with a peak of 366 percent over base sediment. Little Smith Creek watershed shows small sediment peaks of around 50 percent or less through the 1980s, and is currently around 30 percent. This is probably due to chronic sediment from roads. The wildfire sediment pattern and the sediment pattern from management mirror the patterns in Big Smith Creek watershed.

Swan Creek watershed shows the highest activity peak for timber harvest and road building in 1964, a surface plus mass wasting peak of 882 percent over base sediment. There was another peak of around 552 percent over base sediment in 1970, and then continued activity in the watershed; a lower rate and decrease in peak sediment is shown, with the current sediment level at 8 percent over base sediment. The effect of the mass wasting event in 1995-1996 on Big Smith Creek cannot be modeled. Chronic sediment from roads is present in all three watersheds.

Sediment Trends for the Middle Fork Clearwater Subbasin Tributary Watersheds: The sediment patterns shown for the Nez Perce face watersheds in the Middle Fork Clearwater subbasin display two distinct patterns. The first pattern is the sediment peaks from wildfire, which occurred before 1940. This represents the natural pattern of pulse disturbances that historically occur in these watersheds and have the most influence on the sediment processes and streamflow regimes. The second pattern is the sediment peaks generated from several repetitions of road building and timber harvest between 1960 and 2000. This pattern represents the change to press disturbances. The wildfire peaks were higher for all three of the watersheds in Figure 4.25, but the recovery of sediment generated after wildfire returns to natural base levels rapidly. The sediment peaks from the roads and timber harvest in the watersheds were not as high as the peaks from fire. In all the managed watersheds, chronic sediment is always present, although at low levels. Sediment never recovers to base level for the 40 year management period.

Figure 4.26: Frequency of Sediment Condition in Sixth Code Watersheds in the Selway and Middle Fork Clearwater Subbasins



The sediment patterns that are displayed for the Clearwater National Forest watersheds show small peaks for wildfire with quick recovery, and large peaks for timber harvest and roads, with chronic sediment remaining throughout the 40-year managed period with some decrease near 2000.

Stream channels evolved with sediment regimes and water yields tied to large pulse disturbances. The effects of long-term chronic sediment and increased water yield over prolonged periods, such as the past 40 years of management, are not fully known. The balance of water yield and sediment input into the system is definitely altered under the management regime.

Frequency of Sediment Condition in Sixth Code Watersheds in the Selway and Middle Fork Clearwater Subbasins (Figure 4.26): Figure 4.26 displays the percent of sixth code watersheds in each of three categories of percent over base sediment yield. It shows how the spatial extent

and timing of sediment yield modeled from the large wildfires of 1889, 1910, 1919 and 1935 is clearly different from that modeled due to road construction and timber harvest that begins about 1955. Although the wildfires resulted in more watersheds being impacted immediately after the fires, recovery occurred within a few years. On the other hand, the chronic sediment yield associated with roads is shown as a continuing effect.

Field Testing and Calibration of the NEZSED Model: NEZSED has been tested against field sampled data in several studies at three scales of watersheds across the Nez Perce National Forest. Nick Gerhardt, Nez Perce National Forest Hydrologist, summarized the following sediment studies in the *South Fork of the Clearwater River Subbasin Steelhead and Bull Trout Biological Assessment*, 1999. The first study compared the measured and modeled natural sediment yields of 15 small watersheds tributary to Horse Creek, which is a tributary of the Meadow Creek watershed draining into the lower Selway subbasin (Gerhardt and King, 1987). These watersheds ranged in size from 0.08 to 0.57 square miles. Annual sediment yield was sampled with sediment detention basins, suspended sediment samples, and streamflow gauging. Of the 15 tributaries sampled, the model over-predicted sediment yield on nine sites and under-predicted on six sites. The mean result was that the model over-predicted by a modest amount.

The second study evaluated data from eight stream gauging stations on the Nez Perce National Forest. The watersheds measured ranged in size from 5.7 to 113 square miles. Three of these were located within the South Fork Clearwater subbasin (Gloss, 1995). At six stations, the field data consisted of suspended and bedload sediment samples, along with streamflow gauging. At two stations, sediment yield was estimated through the use of sediment detention basins and streamflow gauging. This study found that NEZSED under-predicted sediment yields at six stations and over-predicted at two stations, when compared to observed data from field sampling during water years 1986 through 1993. For the three stations within the South Fork Clearwater subbasin, field-sampled sediment yields averaged about 30 tons/mi²/year and modeled sediment yields averaged about 12 tons/mi²/year. In general, the model predicted better in average to below average water years, and more significantly under-predicted in above average water years.

The third sediment study to test the NEZSED model compared field sampled and modeled sediment yield at the subbasin scale using data for the Selway River and the South Fork Clearwater River (USDA Forest Service, 1995; Gerhardt, 1992). The South Fork Clearwater data was collected at the Mt. Idaho Bridge, near the forest boundary where the watershed area is about 830 square miles. Sampling occurred between 1988 and 1992 and consisted of a relatively small set of unsuspended sediment samples (n=52). When calculated as annual sediment yield, these data suggest an annual sediment yield at this site of 17,880 tons/year, or about 22 tons/mi²/year. Sediment yield predictions at this site, based on NEZSED, were estimated to be 15,080 tons per year, or about 18 tons/mi²/year. Thus, the model compared favorably with annual sediment yield estimates using field-sampled data. The Selway River data was field sampled at the O'Hara gauge on the lower Selway River where the watershed area is about 1,910 square miles. Sampling occurred between 1988 and 1992 and consisted of a relatively small set of suspended sediment samples (n=52). When calculated as annual sediment yield, these data suggest a sediment yield at this site of 54,900 tons/year, or if adjusted to the mouth, 55,700 tons/year. The watershed area at the mouth is 1,974 square miles, so the sediment production is 28 tons/mi²/ year. Sediment predictions based on modeled sediment at the mouth of the Selway River were 54,400 tons/year or about 27.5 tons/mi²/year. Thus, the model compared favorably with annual sediment yield estimates using field-sampled data (USDA Forest Service, 1995).

Watershed Processes And Conditions

Current Watershed Condition: In 1992, a coarse filter watershed condition analysis was completed for the Nez Perce National Forest (Gloss and Gerhardt, 1992). This assessment considered watershed sensitivity (erosion potential and channel type), disturbance indicators (road density, timber harvest, fire, grazing, and mining), and the condition of streams relative to

the forest plan objective to derive a low, moderate or high rating for each watershed. Watershed sensitivity as defined in that analysis is shown on Map 15. Watershed sensitivity was derived from a forest-wide soil erosion hazard map and from generalized channel type groups within each watershed. Some small watersheds, such as the face drainages along the Selway and Middle Fork Clearwater Rivers were excluded from the analysis. Private lands were considered only if they were internal to predominately national forest lands.

The results for the 1992 watershed condition analysis are shown on Map 16, expressed as high, moderate, and low integrity. The analysis found across the Nez Perce National Forest, 52 percent of the area analyzed rated high integrity, 25 percent rated moderate, and 22 percent rated low. Within the Selway basin, the current thinking during the 1992 analysis of wilderness watersheds considered the wilderness watersheds as managed primarily for natural condition as opposed to some particular level of natural potential. Therefore, the wilderness watersheds were rated high integrity unless significantly disturbed by human activity. The affects of fire were not considered in the analysis of wilderness watersheds, but are analyzed later in this document. Watersheds on the lower Selway and Middle Fork Clearwater Rivers where some management activities occurred were rated moderate integrity, and O'Hara Creek watershed was rated low integrity due to mass wasting and erosion, mainly related to roads. This may have changed, due to the high concentration of restoration work in the O'Hara watershed to reduce road densities and restore fish habitat features in the channel.

In the 1992 report, the watershed condition results were expressed as high, moderate and low integrity. The terms concern and integrity are essentially opposites as used in this context. The results are the same, but the scales have been reversed.

Disturbance indicators are used to index watershed condition based on their effects on runoff or erosion processes. Disturbance indicators are related to natural disturbances such as wildfire and human activities such as road building and timber harvest. Wildfire is the main disturbance in wilderness watersheds resulting at times in a high percent of tree stand removal in wilderness watersheds. This can result in increased sediment, mass wasting and peak flows. In managed watersheds roads affect runoff processes through creation of impervious surfaces and disruption of subsurface flow patterns. Roads also expose soil and change slope conditions, which nearly always results in increased surface erosion and can result in accelerated rates of mass erosion, relative to natural conditions. Timber harvest effects are generally not as severe on a per unit area basis as roads, but generally result in increased erosion. The magnitude of timber harvest effects (aside from roads) is similar to fire, although substantial differences exist between timber harvest and fire effects.

Other significant human impacts in the lower Selway and Middle Fork Clearwater subbasins such as grazing, mining, subdivisions on river corridors, and agricultural practices are discussed in narrative form. Quantitative disturbance indicators are not readily available or commonly used for these activities. The *Nez Perce National Forest Plan* displays fish and water quality objectives for watersheds, and these are displayed on Map 18 in this assessment.

Table 4.20 summarizes road miles, road density, timber harvest acres, equivalent clearcut area, percent over base sediment yield, fire acres 1936 to present, and percent harvest for each watershed within ERUs.

Table 4.20: Watershed Condition Indicators

ERU	Cumulative Effects Watershed	Acres (Area)	Road (Miles)	Road Density (Miles per Mile ²)	Timber Harvest (Acres)	ECA (Percent)	Sediment Yield (Percent)	Fire Acres (1936 to Present)	Harvest (Percent)
North Selway Face	Boyd Creek	3,664	2.8	0.48	-0-	0.10		32	-0-
	Nineteen Mile Creek	1,988	0.6	0.31	82	0.08		-0-	0.04
	Glover Creek	5,695	-0-	.008	-0-	0.05	-0-	-0-	-0-
	Twenty Three Mile Creek	1,599	2.5	0.06	-0-	0.11	-0-	-0-	-0-
	Rackliff Creek	5,390	3.6	0.46	135	0.07	-0-	-0-	0.03
	Slide Creek	2,379	1.3	0.34	-0-	0.11	-0-	203	-0-
Upper Selway Canyon	30102 Face Watershed	38,286	-0-	*1	-0-	*1	*1	14,518	-0-
	Bad Luck Creek	21,370	-0-	-0-	-0-	0.01	-0-	1,278	-0-
	Crooked Creek	25,038	-0-	-0-	-0-	0.01	-0-	3,248	-0-
	Magruder Creek	9,381	9.40	0.66	-0-	0.00		-0-	-0-
	Upper Selway Basin	98,078	4.21	0.023	-0-	0.17	-0-	36,749	-0-
	Snake Creek	10,997	5.31	0.31	-0-	0.01	-0-	691	-0-
	Wynntest Creek	5,883	8.82	0.96	-0-	0.03	0	527	-0-
Lower Selway Canyon	30201 Face Watershed	19,427	27.5	*1	334	*1	*1	397	0.02
	Johnson Creek	1,788	0.9	0.37	-0-	0.03		0-	-0-
Middle Selway Canyon	30203 Face Watershed	61,342	9.4	*1	-0-	*	*1	8,295	-0-
Gedney & Three Links	Three Links Creek	27,560	-0-	-0-	-0-	0.05	0	3,624	-0-
	Gedney Creek	31,439	7.4	0.17	-0-	0.05	0	-0-	-0-
Pettibone	Bear Creek	114,307	-0-	-0-	-0-	0.04	0	27,406	-0-

ERU	Cumulative Effects Watershed	Acres (Area)	Road (Miles)	Road Density (Miles per Mile ²)	Timber Harvest (Acres)	ECA (Percent)	Sediment Yield (Percent)	Fire Acres (1936 to Present)	Harvest (Percent)
and Bear	Pettibone Creek	21,486	-0-	-0-	-0-	0.18	0	16,031	-0-
Clear Creek	Clear Creek	65,081	211.9	2.94	9,507	0.10	6	157	0.15
Deep Creek	Deep Creek	36,260	-0-	0.40	-0-	0.02	9	2,031	-0-
Ditch Creek	Ditch Creek	11,510	-0-	-0-	-0-	0.03	0	1,625	-0-
Running and Goat	Goat Creek	18,867	-0-	0.00	-0-	0.02	0	928	-0-
	Running Creek	57,633	10.6	0.11	-0-	0.01	0	137	-0-
O'Hara and Goddard	Goddard Creek	9,251	22.6	1.80	1,056	0.10	6.4	-0-	0.11
	Elk City Creek	1,800	2.0	0.99	213	0.06		-0-	12
	Falls Creek	7,582	21.0	2.12	827	0.11		266	0.11
	Swiftwater Creek	3,925	17.3	2.7	617	0.12	15	-0-	16
	O'Hara Creek	37,898	100.2	1.79	4,273	0.08	7	871	0.11
	Island Creek	3,866	6.8	1.45	291	0.07	6	59	0.08
Indian Creek	Indian Creek	31,991	.32	0.006	-0-	-0-	0	191	-0-
Selway Headwaters	Little Clearwater River	45,478	8.90	0.13	-0-	0.01	0	363	-0-
Martin Creek	Martin Creek	20,973	-0-	0.00	-0-	0.03	0	969	-0-
Meadow Creek	Meadow Creek	155,309	67.1	0.27	1,085	0.02	1	1,876	0.01
Middle Fork Clearwater Face	Middle Fork Clearwater	74,720	282.90	2.70	2,062	0.05		55	0.03
Otter and Mink	Mink Creek	10,229	-0-	0.00	-0-	0.03	0	1,091	-0-
	Otter Creek	10,534	-0-	.002	-0-	0.03	0	-0-	-0-
Moose Creek	Moose Creek	233,208	-0-	-0-	-0-	0.04	0	32,058	-0-
White Cap Creek	White Cap Creek	84,785	1.65	0.012	-0-	0.03	0	17,043	-0-
Total		1,427,977	837.00		20,482			172,719	

*1 The face watersheds are a composite of watersheds. Indicators such as road density, ECA, and percent over natural sediment are indicators used for true watersheds, not composites of

watersheds.

Watershed Area, Timber Harvest, Road Miles, and Timber Harvest Percent: from watershed database as of 12-12-98.

Road Density: from GIS overlay of roads using INFRA database, 3-15-99.

ECA: from the watershed database and fire history GIS layer, 3-2-99

Sediment Yield: from NEZSED runs as of 1998, projected sediment yield over base.

Fire Acres: from the fire history layer, 1936 to present.

Road densities relative to watershed condition have been rated on various scales, depending on the study and its assumptions. In the 1992 Nez Perce National Forest coarse filter analysis, road density less than 1 mile per square mile was rated "low", 1 to 3 miles per square mile was rated "moderate", and greater than 3 miles per square mile was rated "high". In the *Interior Columbia River Basin Science Document* less than 0.7 was "low", 0.7 to 1.7 was "moderate", 1.7 to 4.7 was "high", and greater than 4.7 was "very high".

The estimated clearcut acre (ECA) thresholds of concern have varied considerably, but typically range between 15 percent and 30 percent of 3rd to 5th order streams. Many of the watersheds in the Selway basin designated as roadless or wilderness have ECA percents between 0 to 5 percent. Most of the areas in the watersheds where vegetation is found as shrub fields or young conifer stands are due to wildfire. Other watersheds that have been managed for timber harvest or roads have ECA percents as high as 16 percent.

Table 4.20 indicates how impacts, primarily from roads, timber harvest, and fire, are distributed throughout the Selway and Middle Fork Clearwater subbasins. This is also illustrated on Maps 6 (Current Sediment Yield Over Natural Base), 17 (Road Densities by Watershed), 33 (Fire History, 1935 to Present), and 56 (Harvest History by Decade). Map 19 (Watersheds With Low Levels of Development) illustrates the high percentage of roadless and wilderness watersheds in the subbasins.

In general, the highest occurrence of fire acres occur in ERUs in wilderness and roadless areas where fires tend to be the largest natural disturbance, and where fire suppression has not been as aggressively applied. Fire acres that burned from 1936 to current times are greatly decreased from the fire acres that burned between 1870 and 1936. There have been 172,719 acres of fire mapped that have burned in the Selway and Middle Fork Clearwater subbasins since 1936 (see Map 33). In the ERUs that have been managed the most for timber harvest and road building (Middle Fork Clearwater River, Clear Creek, and O'Hara and Goddard), only 1,805 acres of fire have been mapped that have burned from 1936 to the current time. This gives a rough idea of the impact of fire suppression on natural fire disturbance cycles.

Relatively, impacts from roads and timber harvest are heaviest in the Clear Creek ERU, watersheds such as Island, Falls, O'Hara, Swiftwater, and Goddard, all within the O'Hara and Goddard ERU, and watersheds such as Big and Little Smith Creek, Lodge Creek, Tahoe Creek and Little Tinker Creek in the Middle Fork Clearwater ERU. Low to intermediate levels of impacts from roads and timber harvest are found in Rackliff Creek and Nineteen Mile Creek in the North Selway Face ERU. Some mostly unmanaged ERUs such as the Lower Selway Canyon, Running Goat, Middle Selway Canyon, and Deep Creek have some impacts from roads that access wilderness trailheads.

Increase in roads, landing and skid trail compaction from historical levels changes the way water is intercepted on the slope and the efficiency in which it is infiltrated into the forest soil. Removal of vegetation has changed the historical water yield regime, increasing peak flows and timing of peak flows.

Channel, Floodplain and Riparian Processes

Riparian areas and floodplains play an important role in how material (for example, sediment and wood) and energy (for example, flowing water and solar radiation) are processed within the aquatic system. Riparian areas support vegetation that either seasonally or continuously requires standing or flowing water. Riparian areas include streamside areas, lakeside areas, wetlands, and areas of high groundwater tables.

The term streamside area is calculated similarly to the riparian habitat conservation area (RHCA) that was introduced through PACFISH (Pacific Anadromous Fish Strategy). Streamside areas are used to describe the area along a stream or wetland. Riparian vegetation provides bank stability and shading along most streams. The degree to which this is important depends on stream size, channel type, and valley form.

Floodplains are low areas adjacent to streams that are periodically inundated when flows exceed bank-full stage. This is typically expected to occur about every 1 to 2 years. Floodplains provide important functions of energy dissipation, effect channel morphology, and also support riparian vegetation. Riparian areas and floodplains are disproportionately important to aquatic and terrestrial species.

Channel types (also known as stream types) are a system of classifying streams based on observable features that have process and functional implications. Basin characteristics that distinguish channel types include thread, entrenchment (access to floodplains), sinuosity, width to depth ratio, gradient, and substrate size (Rosgen, 1994). Channel types are significant in that various stream types process energy (water) and sediment in different ways. Channel types are further described and diagrammed in Appendix D, Aquatic Landtype Associations.

A given set of disturbances, such as flood, drought or fire, or changes in sediment yield can have varying effects depending on the channel type and magnitude of disturbance. Channels that have fine substrates in bed and banks are more sensitive to disturbance than channels that have cobble or bedrock substrates and stream banks. The concept of stream valley confinement is important. This term refers to the width of the valley floor relative to the stream width. Natural streams flowing in unconfined valleys are generally meandering, relatively low gradient, have substantial floodplains, and are free to migrate across the valley floor. Streams flowing in confined valleys are usually more linear, have a steeper gradient, have discontinuous floodplains, and tend to remain in place over time.

Aquatic Landtype Associations: Aquatic landtype associations (ALTAs) are ecological land units used to delineate areas with characteristic and distinguishable stream pattern, families of stream order and gradient, and broadly similar climatic, terrestrial and aquatic disturbance regimes and geologic groups. The Selway and Middle Fork Clearwater subbasins were mapped to show ALTAs. Map 10 displays the ALTAs referred to in the following discussions of channel types within the ALTAs.

ALTAs 1 and 2, which are glaciated ridges and slopes on granitic soils, dominate the Selway headwaters in the high elevations. These landforms are found above 5,500 feet and form the headwaters of streams such as White Cap, Moose, Pettibone, Bear, Deep, Marten, Ditch, and Otter Creeks and other streams. Streams flow through valleys that alternate between steep cirque or trough walls and low gradient valley bottoms.

The 1st and 2nd order streams are usually high gradient A or B channel types. They can be prone to channel scour during rapid snowmelt. The runoff regime is dominated by snowmelt. In the 3rd to 5th order streams, there are usually low to moderate gradients with some higher gradient reaches. Channel types are often E or C in low gradient glacial valleys and high elevation meadows. B channels are common in steeper glaciated valleys and some A reaches occur, especially where the gradient is controlled by large boulders or bedrock cascades. The steep

tributary streams deliver material to larger order streams of lower gradients. This happens in pulses and is related to events such as fires, intense thunderstorms or rapid snowmelt. Lower reaches of the upper Selway streams change to steep A channel types as streams drop over breaklands to the Selway River Canyon. (See Appendix C for more information on channel types).

ALTA 5 includes low gradient glacial valley bottoms found along Moose Creek, East Moose Creek, Bear Creek and White Cap Creek. Channel types in this ALTA are B2 and B3 in forest and shrub-land, and C3 and C4 in meadow complexes. The streams are poorly to moderately confined and the hydrologic regime is dependent on snowmelt. Stream order in ALTA 5 is 5th to 6th order. Pulse events such as fire and floods, thunderstorms, debris torrents and spring runoff can affect 1st to 3rd order streams flowing into ALTA 5. This results in deposition such as alluvial fans and woody debris that contributes to bar formations and pool formations at tributary mouths.

The confined canyons of ALTA 7 are found in the lower Middle Fork Clearwater River subbasin. This ALTA is located in the lower half of the Middle Fork Clearwater ERU. Streams include lower Clear Creek, Maggie Creek, Sutter Creek, Big Horse Canyon and other small face watersheds. The landform is steep breakland on basalt bedrock below 5,000 feet elevation. The channels are confined in V-shaped valleys with steep slopes and moderate to steep stream gradients. The streams are linear, have almost no floodplain, and are typically 1st to 3rd order drainages. Channel types are mostly A, with smaller reaches of B. Snow pack is low, and rain-on-snow events can occur. Snowmelt is rapid and smaller face drainages are often intermittent. Mass wasting and debris torrents are part of the channel formation process. Watersheds in ALTA 7 in the lower Middle Fork Clearwater subbasin have been affected by road construction, timber harvest, grazing, and farm practices. Watersheds such as Maggie Creek, Big Horse Canyon, Lytch Creek, and Clear Creek show formation of alluvial fans at the mouth due to aggradation of alluvium. During the 1995 and 1996 winter storms, many small steep face drainages in the Middle Fork Clearwater subbasin experienced debris torrents that scoured the channels.

ALTA 15 consists of plateau landforms on the lower Middle Fork Clearwater River that are formed on basalt. These landforms are found in Clear Creek, Leitch Creek, Maggie Creek, Big Horse Canyon and other Middle Fork face watersheds. Most of the streams are 1st and 2nd order headwater streams with A or B channel types. The headwaters of the streams originate on the basalt plateaus and drop steeply from the plateau over the breaklands to the Middle Fork Clearwater River.

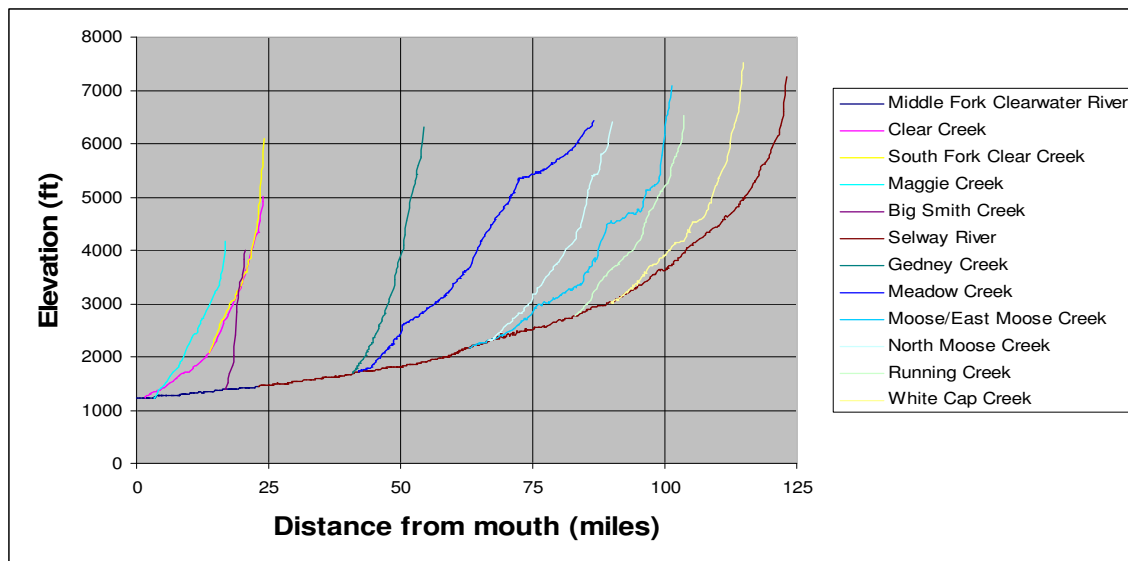
In the Middle Fork Clearwater River ERU the geology type changes from basalt to the Precambrian Belt rock metamorphics around Sutter Creek. ALTA 8 extends up the Middle Fork canyon and the Selway canyon on low elevation breaklands below 5,000 feet to Moose Creek. ALTA 3 occurs on low elevation breaklands on granitics below 5,000 feet and extends from Moose Creek to the Selway headwaters. The channels are steep to moderately steep and confined to V-shaped channels. The channel types are predominately A, with a smaller amount of B in short reaches. The steep reaches of these streams have large cobble and boulder substrate and transport water and sediment quickly to the mainstem Middle Fork Clearwater and Selway Rivers. Examples of these streams include Island, Falls, Elk City, Big Smith, Swan, Nineteenmile, and Johnson Creeks and the lower reaches of larger watersheds. Rain-on-snow and debris torrents are common processes and have been recorded as occurring during floods every 10 to 15 years on south aspects. ALTAs 3, 7 and 8 also include larger more complex streams as they drop steeply into the main rivers.

Channel Gradients: Figure 4.27 shows longitudinal profiles of the Selway and Middle Fork Clearwater Rivers and major tributaries. These profiles show the channel gradients at distances from the mouth. Some key features can be noted along individual streams. For example, the Middle Fork Clearwater River has a relatively consistent, low gradient. The Selway River has a consistent, moderate gradient until around 5 miles below Moose Creek. The gradient of the

Selway River profiles becomes gradually steeper until it becomes markedly steeper at the confluence of White Cap Creek and continues until the headwaters.

Relatively steep reaches occur in general in Maggie Creek, Clear Creek, Big Smith Creek, Gedney Creek, and reaches of Meadow, Moose, North Moose, Running and White Cap Creeks. Moderate reaches occur in lower portions of valleys such as Clear Creek, Moose Creek, Running Creek, White Cap Creek, and North Moose Creek. The lowest gradient reaches occur in meadows, such as upper Meadow Creek, East Moose Creek, and short reaches in upper White Cap Creek and Running Creek.

Figure 4.27: Longitudinal Profiles of the Middle Fork Clearwater River, Selway River, and Selected Tributaries



Within the Selway and Middle Fork Clearwater subbasins, most channel types are currently similar to those of presettlement times. Natural disturbances may have occasionally altered channel types from one state to another through erosional and depositional processes. There has been some change in the channel building and forming processes due to loss of natural disturbances such as wildfire. For example, a large wildfire followed by debris torrents would result in large inputs of wood, organic matter and sediment into the channel, reshaping it.

Human disturbances have resulted in some channel type changes within the subbasins. This has mainly occurred in a few watersheds and is discussed in the following section.

Stream Channel Conditions: Streams in the upper part of the Selway subbasin are located in the Selway-Bitterroot Wilderness and Frank Church River of No Return Wilderness. The streams are considered to be in near natural condition, except for road construction along the streams in Deep Creek, Running Creek, upper Selway River and Magruder Creek. Recent large fires have been the other main disturbance in the upper Selway subbasin watersheds. Refer to Maps 32 and 33 for the fire history. Streams in the Middle Selway basin are also assumed to be functioning close to their natural potential because they are located in wilderness or roadless areas where very little management has occurred. One exception to this is the Horse Creek watershed that flows into the Meadow Creek watershed. Horse Creek is included in a paired watershed study that compares the effect on sediment in a managed watershed with timber harvest, road construction, and prescribed fire treatments, to East Fork Horse Creek, which is an unmanaged control watershed.

Watersheds in the lower Selway subbasin below the wilderness have a wide range of conditions. The main human activities that have affected the stream channel conditions are road building and timber harvest. There has been very little mining activity. Cattle grazing effects are minimal and occur only in the headwaters of Meadow Creek and some of the Middle Fork face watersheds. Watersheds on the south side of the Selway River that have been effected by timber sale and road construction activities are Island Creek, Falls Creek, O'Hara Creek, Goddard Creek, Swiftwater Creek, and Elk City Creek. Road building and timber harvest have had more effect on O'Hara Creek than the other watersheds. Restoration in the past 4 years has decommissioned 20 miles of road. Fish habitat in-channel restoration work is planned for 2000.

Watersheds on the north Selway face of the Selway River canyon below the wilderness boundary have had some road building and timber sale activity, but not to the extent that stream channel conditions were altered to a large extent. The lower reaches of some of the watersheds, such as Boyd, Gedney, Glover, and Nineteenmile may have some in-channel effects from the debris removal efforts after the 1964 floods. The lower 500 feet of Nineteenmile Creek was channelized using gabions after a large debris torrent in 1965. Most of the middle to upper reaches of these streams still function close to natural potential.

Streams on the Middle Fork face located in the Clearwater National Forest have also had a history of timber harvest and road building. Of the smaller face watersheds, Lodge Creek has been effected the most, showing an increase in channel erosion from debris torrents that may be related to peak flows and increased water yield related to clearcutting over 50 percent of the headwaters in the 1960s and 1970s. Other small face watersheds on the Nez Perce National Forest have steep channels that are in good to excellent condition, as shown in the 1996 stream surveys.

Some of the smaller face watersheds on the Middle Fork Clearwater River show aggradations in the form of gravel alluvial fans at the mouth. Some examples are Maggie Creek and Big Horse Canyon. The deposition of alluvial fans is probably related to erosion from roads, agricultural practices in the headwaters, and timber harvest, which increase water yield and sediment in the stream and increase in-channel erosion.

Clear Creek watershed has a high streamside road density, and the channel has been altered by road construction and timber harvest in both the upper tributaries and main Clear Creek. Within the agricultural reaches, the channels have been heavily modified by vegetation removal, bank breakdown from grazing, road and residential encroachment, and sediment and bedload deposition related to these activities. The gradients in lower Clear Creek drop considerably and substantial bedload has been deposited at the mouth due to past flood events and in-channel erosion.

Streamside and Riparian Conditions: Streamside areas are the areas adjacent to streams that have the greatest effect on the aquatic environment. As discussed above, changes in riparian functions have occurred due to human activity. Map 11 shows the streamside activities that have had the most effect on influencing streamside and riparian processes. The major influences have been from road building, campgrounds, and subdivisions. Change in riparian function, as it relates to aquatic function, was assessed using: (1) timber harvest acres in the stream zone, (2) stream-side road miles, (3) streamside road density, and (4) indicators of stream crossings in the streamside area such as stream crossings per mile and streamside road density. These listed indicators were rated to assess effects on riparian function, as shown in the last column in Table 4.21. The streamside road density was rated using the road density classes as described in the *ICRB Science Assessment*.

Table 4.21: Change in Streamside Conditions

ERU	Watershed	Streamside Acres	Percent of CEW	Streamside Harvest Acres	Streamside Harvest Density Rating	Streamside Road Miles	Streamside Road Density	Streamside Road Density Rating	Stream Crossings/Mile	Stream Crossing Rating	Effect on Riparian Function
North Selway Face	Boyd Creek	718	20			.13	.12	Low	.15	Mod	Low
	Nineteen Mile Creek	363	18			.05	.09	VL	.17	Mod	Low
	Glover Creek	1,134	20			.06	.024	VL	.05	Low	Low
	Twenty Three Mile Creek	288	18			.03	.07	VL	.16	Mod	Low
	Rackliff Creek	934	17	0		.13	.11	Low	.05	Low	Low
	Slide Creek	357	15			.02	.03	VL	.14	Mod	Low
Upper Selway Canyon	30102 Face Watersheds	8774	23								
	Bad Luck Creek	5,521	25								
	Crooked Creek	4,809	06								
	Magruder Creek	1,902	20			3.52	1.12	Mod	.25	Mod	Mod
	Upper Selway Basin	19,551	20			.79	.03	VL	.01	Low	Low
	Snake Creek	2,264	21			5.31	1.50	Mod	.13	Mod	Mod
	Wynntest Creek	1,287	22			8.43	4.19	Mod	.27	Mod	High
L. Selway Canyon	30201 Face Watersheds	4,205	22	21	VL	19.78	3.01	High	.30	Mod	Mod
	Johnson Creek	305	17			.20	.41	Low	.35	Mod	Low
Middle Selway Canyon	30203 Face Watersheds	13,337	22			3.43	.28	Low	.08	Low	Low
Gedney and Three Links	Three Links Creek	4,937	18								
	Gedney Creek	5,444	17			.20	.024	Low	.03	Low	Low
Pettibone and Bear	Bear Creek	19,670	14								
	Pettibone Creek	4,061	19								

ERU	Watershed	Streamside Acres	Percent of CEW	Streamside Harvest Acres	Streamside Harvest Density Rating	Streamside Road Miles	Streamside Road Density	Streamside Road Density Rating	Stream Crossings/Mile	Stream Crossing Rating	Effect on Riparian Function
Clear Creek	Clear Creek	10,636	16	1,359	High	43.43	2.66	High	.74	High	High
Deep Creek	Deep Creek	7,130	20			14.43	1.30	Mod	.24	Mod	Mod
Ditch Creek	Ditch Creek	2145	17								Low
Running and Goat	Goat Creek	4,456	24								Low
	Running Creek	13,711	24			2.89	.13	Low	.04	Low	Low
O'Hara and Goddard	Elk City Creek	258	14	5		.27	.67	Low	.65	High	Low
	Falls Creek	1,149	15	80	High	.88	.50	Low	.47	Mod	Mod
	Goddard Creek	1,523	16	88	High	1.03	.44	Low	.29	Mod	Mod
	Swiftwater Creek	537	14	61	High	.62	.73	Mod	.37	Mod	Mod
	O'Hara Creek	7,259	19	346	Mod	16.91	1.49	Mod	.56	High	Mod
	Island Creek	474	12	17		.16	.20	Low	.17	Mod	Low
Indian Creek	Indian Creek	5,678	18			.32	.036	VL	.01	Low	Low
Selway Headwaters	Little Clearwater River	10,751	24			.50			.01	Low	Low
Martin Creek	Martin Creek	4,154	20			0.0					
Meadow Creek	Meadow Creek	29,258	19	180	Low	4.90	.11	Low	.04	Low	Low
Middle Fork Clearwater Face	Middle Fork Clearwater	11,917	16	572		59.9	3.24	High	.77	High	High
Otter and Mink	Mink Creek	2,056	20			0.0					
	Otter Creek	1,992	19			.04					Low
Moose Creek	Moose Creek	40,629	17			.05					Low

ERU	Watershed	Streamside Acres	Percent of CEW	Streamside Harvest Acres	Streamside Harvest Density Rating	Streamside Road Miles	Streamside Road Density	Streamside Road Density Rating	Stream Crossings/Mile	Stream Crossing Rating	Effect on Riparian Function
White Cap Creek	White Cap Creek	15,239	18			1.54	.06	VL	.009		Low
Total		403,678				146.87					

Ratings in Table 4.21 were defined using the following measures:

Streamside Area (calculated using the GIS layer):

- 300 feet for perennial streams with fish
- 200 feet for other streams.

Streamside Harvest Density:

- Very High: greater than 15 acres of harvest per 100 acres of streamside area
- High: between 5 to 15 acres of harvest per 100 acres of streamside area
- Moderate: between 2 to 5 acres of harvest per 100 acres of streamside area
- Low: between 0.5 acres of harvest per 100 acres of streamside area
- Very Low: less than 0.5 acres of harvest per 100 acres of streamside area

Streamside Road Density (using Quigley, 1997 road density classes):

- Very High: greater than 4.7 miles per square mile
- High: between 1.7 to 4.7 miles per square mile
- Moderate: between 0.7 to 1.7 miles per square mile
- Low: between 0.11 to 0.7 miles per square mile
- Very Low: less than 0.1 miles per square mile

Stream Road Crossings Per Mile:

- Very High: greater than one crossing per mile
- High: between 0.5 to 1 crossing per mile
- Moderate: between 0.1 to 0.5 crossing per mile
- Low: between 0 to 0.1 crossing per mile

Stream Road Crossings Per Mile Square

- Very High: greater than one crossing per square mile
- High: between 0.5 to 1 crossing per square mile
- Moderate: between 0.1 to 0.5 crossing per square mile
- Low: between 0 to 0.1 crossing per square mile

See Map 12 for streamside road densities, Map 13 for streamside areas, and Map 14 for road crossings per mile.

Summary Of Hydrologic Analysis

Physical aquatic conditions in the upper Selway subbasin have not changed substantially since the initiation of human disturbances in the early 1900s, except in a few watersheds.

Upper Selway Canyon ERU: The greatest change in the Upper Selway Canyon ERU is related to the road along Deep Creek and the upper Selway River. This road encroaches on the stream, decreasing the width of riparian function, increasing sediment from road sources, and increasing in-channel erosion. These changes also affect the condition of fish habitat. This road also has had a strong effect on the sediment regime of the Selway River as shown in the sediment modeling. Using the stream condition indicators to rate roads effects, the Upper Selway Canyon ERU is rated moderate for effect on riparian function.

North Selway Face ERU and Gedney and Three Links ERU: Riparian function in the Selway subbasin below Paradise to the wilderness boundary has not been significantly affected by human activities. There may be a slight effect on availability of wood in streams due to fire suppression. The North Selway Face ERU and the Three Links and Gedney ERU have been somewhat affected by human disturbances. All watersheds in the North Selway Face ERU have some effects from human activities such as a very small amount of road mileage (< 0.2 miles of road in the riparian zone) and low to very low streamside road densities. Removal of logjams and some logging of cedar in the riparian zones have affected the lower reaches in some watersheds. There has not been a significant change from the historical condition in the riparian function resulting from roads or timber harvest. The effect of historic logjam removal needs to be further investigated.

O'Hara and Goddard ERU: In the O'Hara and Goddard ERU significant change has occurred in streamside condition since the initiation of human activities in the mid 1900s. The rating shown in Table 4.21 for the effect of streamside timber harvest on riparian areas is rated high for three watersheds in this ERU. O'Hara Creek is rated high for effect on riparian function, because it has the combined effects of streamside harvest and road encroachment on the lower 3 miles of the watershed. Other watersheds that have experienced significant effects to streamside condition due to riparian harvest and roads are Fall Creek, Swiftwater Creek, and Goddard Creek.

Middle Fork Clearwater River ERU: The Middle Fork Clearwater River ERU has changed significantly due to human activities since the early 1900s. This ERU, which has managed watersheds such as Lodge Creek, Little Tinker Creek, Tahoe Creek, Big and Little Smith Creeks, and Swan Creek, has an overall rating of high streamside road densities, moderate streamside harvest effects, and high number of stream crossings per mile. Suttler Creek and Maggie Creek also have had intensive timber harvest and road building activities, but are not shown on the table. The condition of this ERU varies by the watershed. This is a general overall rating.

Clear Creek ERU: Clear Creek ERU had changes similar to those of the Middle Fork Clearwater River ERU. Clear Creek ERU has a high rating for the effects of harvest and roads on streamside areas. This watershed has changed substantially since the early 1900s, not only from roads and timber harvest, but also from stream channelization, agricultural practices, grazing, and aggradation on lower reaches from floods.

AQUATIC HABITATS

This section discusses aquatic habitats in the Selway and Middle Fork Clearwater subbasins. The time period referred to in the subsections covering historic conditions is presettlement, as in the rest of this assessment.

MOUNTAIN LAKES

Historic Conditions Of Lakes In The Selway Subbasin

Physical Characteristics: More than 350 mountain lakes were scattered across the headwaters areas of many tributaries of the Selway River. Most lakes occurred at elevations greater than 5,500 feet and were included in one of the following geomorphic types: (1) cirque lakes - formed by rotational pluck and scour action of mountain glaciers and located in a bowl under a peak, flanked on three sides by steep walls; (2) cirque-scour lakes - located down-valley of a headwall

and usually occupying basins scoured of less-resistant bedrock; (3) paternoster lakes - consisting of chains of at least three cirque-scour lakes; (4) upland lakes - lake basins scoured by an ice cap on gently rolling surfaces; and (5) lakes of other varieties, including those formed by beaver dams and landslides.

All lakes in the Selway subbasin were located in Aquatic Landtype Association (ALTA) 2. In general, lake productivity varied by elevation, depth, amount of littoral zone, exposure, and shoreline development. Most lakes were oligotrophic and were characterized by cold, clear water with low dissolved solids and low conductivity. Lakes were generally free of ice five to six months out of the year. Lake size varied considerably, and ranged from less than one acre to greater than 150 acres. Lake depth was also highly variable, with many lakes less than one meter in depth, and some with depths greater than 30 meters. Deeper lakes experienced both spring and fall turnover, while shallow lakes simply warmed and cooled depending on ambient temperature. Shallow lakes were generally frozen solid during the winter except where groundwater upwelling occurred, while deeper lakes rarely, if ever, froze from surface to substrate. Inlet streams of varying number and size fed most lakes, but snowmelt and/or groundwater upwelling maintained a few.

Biological Characteristics: Mountain lakes in the Selway subbasin generally supported unique ecosystems distinct and different from streams. Despite a lack of productivity, many mountain lakes supported a rich array of aquatic vertebrate and invertebrate species, in addition to vascular and non-vascular aquatic plants. Mountain lakes were also important areas for terrestrial animals, providing summer and fall feeding areas for animals such as moose, elk, and insectivorous birds.

Mountain lakes supported diverse assemblages of zooplankton, with the following families, orders, and genera represented: Bosmina, Chydoridae, Daphnia, Diaphanosoma, Holopedium, Polyphemus, Sida, Scapholeberis, Calanoida, Diaptomus, Cyclopoida suborder, Chaoborus, Harpacticoida suborder, Macrothricidae, and Alona. The following aquatic plant taxa were present: Callitriche, Carex, Eleocharis, Equisetum, Fontinalis, Juncus, Isoetes, Nuphar, Potamogeton, and Sparganium. At least 150 macroinvertebrate taxa were present.

Mountain lakes also provided important habitat for aquatic vertebrates. Amphibians found in some or all mountain lakes included western long-toed salamanders, tailed frogs, western spotted frogs, and Pacific giant salamanders. Most lakes in the subbasin were fishless. Six lakes in the subbasin, however, probably supported indigenous westslope cutthroat trout. Cutthroat trout in these lakes probably migrated freely between the lakes and the streams, with spawning occurring in the streams. Cutthroat trout in lakes may have grown faster and matured earlier than those in streams, resulting in high numbers of small fish in the lake population.

Departure From Historic Conditions of Mountain Lakes in the Selway Subbasin

Physical Characteristics: Approximately 347 mountain lakes currently exist in the Selway subbasin. Physical characteristics of lakes are probably similar to historic conditions. The natural succession of lakes, which often involves an increase in deposition, encroachment by vegetation, and eventual transformation of the lake to a wetland or wet meadow, may have resulted in fewer lakes currently than existed since the last ice age. This process may also have resulted in some lakes becoming shallower, and increases in littoral zone areas and adjacent wetlands. Many other lakes are probably unchanged.

The riparian areas and adjoining lands around some lakes have been altered by human use. Some mountain lakes attract a higher density of visitors than others due to their aesthetic appeal, and the introduction of trout to the lakes. High visitor use has resulted in establishment of campsites, trails, and impacts from packstock. Specific changes at these sites include trampling and compaction of soil and vegetation, removal of down dead wood, establishment of fire rings, mortality of trees from stock tying, impacts on streambanks and lakeside areas from packstock, and introduction of noxious weeds. The degree of human impact appears positively correlated

with presence of fish in the lake, size of the lake, ease of access by foot or stock, and the presence of nearby lakes (Bahls, 1987). All lakes rated with high or very high human impacts currently support fish.

Biological Characteristics: The biological characteristics of many mountain lakes in the Selway subbasin differ significantly from historic conditions. The primary causative factor of this difference is the introduction of hatchery trout to historically fishless lakes. Survey data suggest the introduction of trout to mountain lakes has resulted in a significant change in the biological communities of zooplankton, aquatic macroinvertebrates, and amphibians indigenous to naturally fishless lakes (Bahls, 1987). Specifically, changes in aquatic communities include significant reduction or elimination of large, open-water zooplankters, reduction of total taxa of zooplankton and macroinvertebrates relative to fishless lakes, and elimination of western long-toed salamanders, whose current distribution in mountain lakes is mostly restricted to those lakes that do not contain fish. In addition, some members of Coleoptera, Notonectidae, Corixidae, and Gerridae, taxa that are large and commonly found on the water surface and in open water, are primarily restricted to fishless lakes (Bahls, 1987).

Of the 347 mountain lakes in the subbasin, 239 (69 percent) have been surveyed. Of these 239 lakes, 136 (57 percent) have been stocked in the past 50 years. Currently, 98 historically fishless lakes (40 percent) now support fish; 142 (60 percent) are currently fishless. Presumably, the biological characteristics of existing fishless lakes are similar to the historic characteristics.

STREAMS

General Physical and Biological Conditions

Streams in the Selway and Middle Fork Clearwater subbasins are highly variable, depending on factors such as gradient, aspect, size, geology, substrate, and upland disturbance regimes. The physical components of streams may be grouped generally by the ALTA in which the stream is found. These components are inextricably linked to upland disturbance regimes and processes. Therefore, streams are highly dynamic, and conditions in a stream at any point in time are a function of change. While rates of change differ among streams, the concept of change applies across the landscape.

The specific biological components of streams are best addressed in the Aquatic Species section. In summary, the most significant change from historic conditions in the biological component is the introduction of non-native trout, which may have resulted in local extirpation and widespread hybridization of westslope cutthroat trout.

The following discussion of habitat components has been roughly divided into four categories, representing landscapes with the following characteristics: (1) breaklands; (2) high elevation glaciated lands; (3) moderate to low relief uplands; and (4) alluvial valleys.

Breaklands

ALTAs 3, 7, and 8 are included in this category (see Map 10).

Historic Stream Process and Function: The process and function of streams in the breaklands differed depending on stream order. Low order streams were subject to extreme events in response to fire and other disturbances. Channels were prone to scour and debris torrents, particularly in drainage headwalls with shallow soils, and channels were subject to major impacts as a result of severe events. Debris torrents were a natural process. Climatic and fire events provided a relatively frequent supply of sediment from surface erosion, mass wasting, and channel scour, which was delivered efficiently downstream to higher order streams. The supply of large wood was often limited by fire frequency on south exposure streams. On north exposure streams, large wood was delivered to streams frequently and stored until the next large flow event or debris torrent. Large wood in the channel provided a measure of channel stability and contributed to the streams' ability to resist change. Low order stream resistance to change was

generally high, especially in ALTA 7, but resilience was low, with many years required to reestablish channel structure and stable vegetated banks following severe events.

Higher order streams, which included third through sixth orders, were generally lower in gradient, with boulders and large cobbles as the dominant substrate. Stream banks were well armored, usually with boulders or bedrock, resulting in high resistance to change and resilience. Sediment transport capacity was high, which resulted in low levels of deposited sediment despite frequent pulses from low order streams. Larger streams were high energy (containing large amounts of fast-moving water) and did not retain large woody debris efficiently. They were highly dependent on upland disturbances to produce large pulses of debris delivered to the streams over a short period of time.

Large woody debris was an important element of breakland streams, integral to channel structure and function, and providing habitat for salmonids. Since larger streams in the breaklands were generally high energy with moderate gradients, they did not retain large woody debris efficiently. These streams, especially the higher order main stem tributaries, were highly dependent on upland disturbances to produce large pulses of debris delivered to the streams over a short period of time. Occasional trees delivered to larger streams were not likely to become stable, long-term fixtures due to the sustained high spring runoff flows in highly confined channels. Large pulses of debris, conversely, often resulted in the formation of large, complex debris jams that were stable and historically functioned as important determinants of pool frequency, habitat complexity, and spawning gravel recruitment in larger breakland streams.

Pulses of debris generally occurred in response to wildfire events and debris torrents in low order tributaries, both of which were frequent and significant natural agents of change. Moderate or high severity wildfires, especially those which resulted in significant mortality of streamside trees adjacent to higher order streams, increased the probability of many trees recruited over a short period of time. Low order tributaries, which more efficiently stored debris even in the absence of disturbance, were also important factors in providing large amounts of debris to high order streams. Floods and debris torrents delivered large amounts of wood over a short period of time, thereby ensuring a pulse of material that was likely to form stable debris jams in fish-bearing streams. Debris torrents occurred more commonly following wildfire events, especially those of high severity, although rain-on-snow events sometimes produced similar results.

Due to formation of complex debris jams, existence of boulders, and moderate stream gradients, pool frequency and pool quality were probably high in some reaches. High sediment transport capability of larger streams resulted in streambeds with low levels of deposited sediment and high water clarity during all but the most extreme flow events. Level of suspended sediment generally increased only in response to debris torrents or other pulse sediment events. High levels were rarely sustained over long periods of time and occurred only in response to widespread lethal fire events.

Where basalt parent materials existed, the level of deposited fine sediment was probably higher. The base level of suspended sediment was also higher, even at low flows.

Spawning habitat for anadromous fish was mostly located in high (third to sixth) order streams along stream margins, at pool tailouts, and in low gradient riffles and runs. Spawning habitat for resident and fluvial fish, including bull trout, was located throughout the fish-bearing portions of all watersheds and concentrated along stream margins and in low gradient reaches. Stable stream temperatures, groundwater upwelling, and high levels of large wood in the stream may have been important determinants of bull trout spawning.

Departure From Historic Conditions in Stream Process and Function: Current stream process and function remain similar to historic stream process and function, with several notable exceptions. The influence of anthropogenic press disturbances both within the breaklands

landscape and lands upstream of the breaklands has resulted in several changes. These changes include an increase in deposited sediment, increased and sustained high suspended sediment levels following moderate and high flow events, decreases in large wood, a reduction in pool frequency, and an overall simplification of habitat. Areas where this has occurred are generally located in the lower reaches of the Selway River and throughout the Middle Fork Clearwater subbasin. Other activities that have contributed to this condition include debris-clearing efforts, which occurred in the 1960s. Removal of debris jams in these streams has resulted in locally significant departures from historic conditions. Removal of woody debris from streams results in a reduced number of pools, reduction in pool quality in remaining pools, reduction in habitat complexity, and reduced resistance to change.

The introduction of noxious weeds, most notably spotted knapweed, has been implicated as possibly increasing surface sediment yield. Lacey and Olson (1991) reported that as knapweed replaces native bunch grasses, forbs, and graminoids, soil erosivity increases. Although the extent of such an impact on process and function of watersheds in the Selway subbasin is unknown, given the extent of the spotted knapweed infestation across the breaklands landscape, it is possible that changes in surface sediment yield, and potentially mass erosion processes, have occurred.

Suppression of wildfire may have significantly affected natural streamflow and sediment regimes in this landscape.

High Elevation Glaciated Lands

ALTAs 2 and 5 are included in this category (see Map 10).

Historic Stream Process and Function: The process and function of streams in glaciated lands varied greatly. Steep, ice-scoured cirques and glacial troughs with inclusions of gently sloping ice-scoured ridges and morainal deposits characterized lands in these ALTAs. Streams generally flowed through valleys composed of steep cirque or trough walls, which were prone to channel scour and debris torrents during periods of rapid snowmelt. Rapid snowmelt was not a common occurrence, however, and streams were therefore more stable than those in the breaklands. Streams were subject to debris torrents after intense wildfire followed by high-intensity thunderstorms, which were fairly common occurrences in the summer and fall. Streams in ALTA 2 were low order and important in determining the process and function of higher order streams. Boulders, bedrock, and large wood were stabilizing factors in ALTA 2 streams. In ALTA 5, streams flowed through low gradient valley bottoms with occasional moderate or high gradient reaches. Low order streams delivered sediment rapidly. Materials such as large substrates or large woody debris commonly accumulated in ALTA 5 streams, and then slowly moved downstream.

Streams in ALTA 5 were higher order and flowed through low or moderate gradient valley bottoms. Occasional high gradient reaches occurred in most ALTA 5 streams. Valley confinement, elevation, soil depth, and aspect were also variable within this ALTA, and streams varied accordingly. For example, valley confinement ranged from low in meadow reaches, where there was a high frequency of large woody debris and high cobble embeddedness, to moderate in forested reaches, with less woody debris and very low cobble embeddedness. Resistance to change varied as well, depending on the composition of bed and bank materials and riparian vegetation. Recovery from disturbance was usually slow. Fire, particularly stand-replacing fire, occurred at long intervals, ranging from 100 to 300 years, with mixed and lethal severity.

Most fish habitat was found in the higher order mainstem tributaries and lower reaches of low-order tributaries in ALTA 5. Large wood was an important determinant of habitat quality and complexity. Although recruitment rates were moderate or low, large wood was usually retained even when recruited discretely. In addition to creating high quality pools, large wood also provided bank stability in moderate and low gradient reaches, provided higher channel stability,

and was an important contributor of nutrients. In general, reaches with high levels of large wood were more productive than those with moderate or low levels. Substrate composition was highly variable, ranging from coarse sand as the dominant substrate in low gradient reaches to large cobble, boulder, and bedrock in moderate and high gradient reaches. High levels of fine sediment deposition were generally not a prevalent feature of stream substrates in the glaciated ALTAs. Water clarity was very high, except during the most extreme precipitation events. Primary production was probably limited by lack of nutrients, cold water temperature, and short summer seasons.

Streams in ALTA 5 provided spawning habitat for resident fish, including both westslope cutthroat trout and bull trout, but lower elevation reaches also provided habitat for anadromous fish where accessible. Spawning habitat for all species was located along stream margins, at pool tailouts, and in lower gradient riffles and runs. Although spawning habitat was abundant and widespread for small resident fish and fluvial cutthroat trout, quality of habitat was increased if gravel was proximate to large wood, which was used for cover by staging and spawning adults and newly emerged fry. Appropriate-size gravels associated with large wood and groundwater upwelling were particularly important for spawning by fluvial bull trout. Such areas were uncommon, but where they occurred, they exhibited a disproportionate level of fluvial bull trout production.

Departure From Historic Conditions in Stream Process and Function: Currently, streams in the glaciated ALTAs function similarly to the historic condition. These ALTAs are located exclusively in designated wilderness and roadless areas and have not sustained anthropogenic disturbance on a large scale. Fine-scale disturbances are present, however, and are associated with trail erosion, fords, human-caused salt licks (resulting in artificially high densities of big game animals and impacts to stream banks), packstock use, and high levels of recreational use. Lands in the glaciated ALTAs are highly sensitive to impact and exhibit both very low resistance to change and resilience, requiring decades for recovery following impact.

The suppression of wildfires starting in the 1930s may have disrupted the normal fire regime in this landscape. Such disruption probably has minimally affected the function and process of streams. Disruption of fire frequency, however, may have resulted in accumulations of fuel, which will ultimately increase fire intensity when fire occurs. Increased intensity, especially if widespread, may result in more severe changes in highly sensitive glaciated streams.

Moderate to Low Relief Uplands

ALTAs 1, 6, 15, 17, and 21 are included in this category (see Map 10).

Historic Stream Process and Function: Although a variety of landscapes are included in the moderate to low relief uplands category, process and function of streams among the ALTAs that make up the area shared some common characteristics. Watersheds were generally moderately or highly dendritic, with streams moderately or highly confined in v-shaped or trough-shaped valley bottoms with variable gradients. Except for ALTA 15, most valley bottoms were forested, but sedge meadows and forest meadow complexes occurred frequently. Mass wasting and severe channel erosion were not common. In ALTA 15, valley bottoms were primarily shrub-dominated.

Channels were not usually subject to extreme events due to lower stream energy, moderate snowpack, slow and sustained runoff, and low incidence of rain-on-snow events. Low order streams transported sediment (sands and larger particle sizes) efficiently through their steeper reaches, which were then stored for extended periods in lower gradient reaches. Surface erosion occurred most significantly in response to wildfires.

Streams in these landscapes were relatively stable and did not change with the frequency seen in other landscapes. Given inherent channel stability, resistance to change, and resilience following

change, habitat remained unchanged over long periods of time. The primary influence was wildfire, which generally occurred at moderate or long intervals and was of mixed severity.

Large wood in streams was an important component of fish habitat, and it contributed significantly to the moderate and high resistance to change. Amount of woody debris in the channel was a function of debris available in the riparian area; debris was not commonly delivered from areas upstream. Recruited debris was retained efficiently on-site, whether delivered discretely or in large numbers. Woody debris was important in creating high-quality pools, especially when associated with channel meanders. In low gradient areas, particularly in meadow reaches, undercut streambanks provided important refuge and cover for fish. Dominant substrates were variable, but low order streams were generally dominated by large and small cobbles while higher order streams had smaller substrates, such as small cobbles and coarse sands.

Of the above ALTAs, ALTA 1 was most significant in terms of habitat potential for fish. A rough correlation between the presence of resident bull trout subpopulations and occurrence of ALTA 1 existed. Spawning habitat for resident fish, particularly bull trout, was generally widespread and located within glides, low gradient riffles, and in pockets along stream margins. Cover for staging adults and newly emerged fry was provided by large woody debris and undercut banks. Streams in the other ALTAs in this category were most important as critical contributors to conditions downstream.

Departure From Historic Conditions in Stream Process and Function: Current stream process and function is similar to historic stream process and function in some areas, and significantly different in others. As a general rule, reaches in ALTA 1 function similarly to the way they did in their historic condition, except for the upper reaches of Meadow Creek. The stream channel in these reaches has been altered by decades of domestic livestock grazing (cattle), which occurred until 1993. The channel exhibits various lengths of bank instability and over-widening over significant lengths as the stream flows through stringer meadows. Although these changes are prevalent, the channel has probably improved since the area was last grazed. Improvement may be hindered, however, by high off-road vehicle use in the meadows and grazing of packstock.

Similarly, reaches in ALTA 21 function as they did historically, with several exceptions. Roads have been constructed across this landscape in the O'Hara, Clear, Running, and Deep Creek watersheds. Road construction has resulted in a press sediment source in these areas, and this may have resulted in increased sediment deposition in streams that do not transport sediment efficiently.

Reaches in ALTA 15 (basalt plateaus) mostly occur off National Forest lands, and existing vegetation is now primarily cropland, hay, and pasture, with some remaining forest land that has been heavily affected by livestock grazing, residential development, timber harvest, and road construction. These activities have resulted in high levels of both deposited and suspended sediment in sensitive basalt watersheds. Streams flowing from these lands are commonly visibly turbid following even minor precipitation events. These streams also exhibit high levels of bedload aggradation at their mouths, indicating that watershed function has been disrupted.

Reaches in ALTA 17 have been affected by road construction and logging. Increases in surface sediment yield have undoubtedly occurred, resulting in higher levels of deposited sediment than occurred historically.

Alluvial Valleys

ALTA 18 is the only ALTA present in this category (see Map 10).

Historic Stream Process and Function: Historic process and function of streams in ALTA 18, comprised of mid- to upper elevation alluvial valleys, varied little among stream types. Although

ALTA 18 comprises a very small portion of the Selway subbasin, its significance is high, and it is considered a rare element. Lands within this ALTA were above 3,000 feet, with low gradient channels that were poorly confined in trough-shaped valley bottoms or flat valleys in canyons. Low gradient channels were usually not resistant or resilient. These areas provided important spawning and rearing habitat for anadromous fish. Streams were generally moderate to high gradient and well to moderately confined in flat valley bottoms with glacial troughs or stream breaklands forming valley walls.

Departure From Historic Conditions in Stream Process and Function: Current stream process and function is similar to historic process and function. Compared to surrounding areas, streams continue to support spawning and rearing habitat of disproportionately high value for anadromous salmonids. Local impacts may have occurred from high recreational use.

AQUATIC SPECIES

The Selway and Middle Fork Clearwater subbasins contain a significant amount of habitat with high to very high potential to support a native aquatic assemblage. The Selway subbasin is extremely important to aquatic resources when considered in the context of the Columbia River basin. Although the bulk of the aquatic species discussion below is devoted to at-risk native salmonids, a significant component of the native assemblage is composed of non-salmonid species. The lack of discussion related to non-salmonids reflects a lack of information on these species, rather than a lack of their importance to the overall aquatic ecosystem. This lack of information is considered a significant data gap, and represents missing information necessary to completely understand the aquatic ecosystem of the Selway and Middle Fork Clearwater subbasins.

The Selway subbasin is considered a critical component for recovery of at-risk native salmonid fishes, given its existing habitat quality, connectivity, and species status.

In addition to at-risk salmonid species, non-salmonid aquatic species within the Selway and Middle Fork Clearwater subbasins may be at-risk as well. Neither historic nor current distribution and abundance of some non-salmonids have been described, and in some cases species have not been identified. It is possible that endemic aquatic organisms currently exist, or existed historically, in mountain lakes in the Selway subbasin.

To summarize the current status of the habitat and populations of westslope cutthroat trout, a classification system that considers habitat potential, habitat condition, and species status has been developed for this assessment.

Areas with high to very high habitat potential are described as: (1) strongholds, where habitat is good and population is strong; (2) population strongholds, where the population is strong but the habitat condition has been degraded; (3) habitat strongholds, where the habitat condition is good but the population is depressed; and (4) historic strongholds, where the habitat condition has been degraded and the population is depressed.

Areas with moderate to low habitat potential are described as: (1) adjunct-secure, where habitat condition is good and the population is strong; (2) adjunct population, where the population is strong but the habitat is degraded; (3) adjunct habitat, where the habitat condition is good but the population is depressed; and (4) adjunct, where the habitat condition is degraded and the population is depressed. This series of classifications uses the term “adjunct” differently than it is typically used, which is to describe areas adjacent to focal or refuge habitats (Frissell, 1993). In this context, “adjunct” is used to describe areas of lesser habitat potential that support populations of the species less continuously than areas of higher potential.

Areas providing subadult/adult rearing, overwintering, and migratory habitat are classified as: (1) nodal - high quality, where habitat condition is high; and (2) nodal - degraded, where the habitat condition has been degraded.

Areas that provide water quality to downstream habitat are called critical contributing areas and are classified as: (1) critical contributing - high quality, where these water quality contributing areas contain high quality aquatic conditions; and (2) critical contributing - degraded, where the aquatic condition in these areas is degraded.

WESTSLOPE CUTTHROAT TROUT (*Oncorhynchus clarki lewisi*)

The U. S. Forest Service Northern Region considers westslope cutthroat trout to be a sensitive species in the Clearwater River basin. The state of Idaho categorizes westslope cutthroat trout as a species of special concern.

Westslope cutthroat trout were once abundant through much of the north and central portions of the upper Columbia River basin. Although this subspecies is still widely distributed, remaining populations may be seriously compromised by habitat loss and hybridization with non-native rainbow and Yellowstone cutthroat trout. Some extension of the natural distribution has occurred through hatchery introductions. Despite wide distribution, there appear to be few remaining healthy populations outside of the central Idaho mountains.

Basin Context

Westslope cutthroat trout in the Selway and Middle Fork Clearwater subbasins represent an important metapopulation in the Clearwater River basin. Other important metapopulations include the Lochsa, South Fork Clearwater, and North Fork Clearwater Rivers. Of these, only the Lochsa River is functionally connected to the Selway River. The Middle Fork Clearwater River functions as a migration corridor and provides winter and early spring habitat for fluvial cutthroat trout. Clear Creek supports spawning and rearing of isolated resident subpopulations which are physically connected to the Middle Fork Clearwater/Selway/Lochsa populations but may be functionally isolated due to habitat degradation in the lower reaches.

The Selway subbasin is considered a core area for recovery of westslope cutthroat trout and was identified as a category 1 subbasin (Quigley et al., 1997). Category 1 subbasins represent systems that most closely resemble natural, fully functional aquatic ecosystems. They provide a system of habitats large enough and well dispersed enough to be resilient in the face of large-scale, catastrophic disturbance. They provide the best opportunity for long-term persistence of native aquatic assemblages and may well be the most important sources for refounding other areas. These areas are generally large enough to deal with catastrophic fire, rare events, and other uncertainties.

Historic Conditions Related to Westslope Cutthroat Trout

Inherent Habitat Capability and Historic Population Dynamics: The Selway and Middle Fork Clearwater subbasins have inherently high capability to support westslope cutthroat trout. This assertion is based on the current status and distribution of the subspecies throughout the assessment area. Habitat capability is discussed in this section as it relates to: (1) the habitat capability of the subbasin to support cutthroat trout spawning and rearing (juvenile rearing for migratory fish); (2) the subbasin's capability to support migration and late rearing of fluvial fish, and; (3) the subbasin's capability to support a metapopulation, or connection of local populations, of westslope cutthroat trout.

Historic key spawning and early rearing areas for fluvial cutthroat trout in the Selway subbasin included most of the upper reaches of O'Hara, Meadow, Gedney, Three Links, Mink, Marten, Moose, Pettibone, Ditch, Bear, Running, White Cap, Goat, and Indian Creeks, the Little Clearwater River, and tributaries to the upper Selway River. The high elevation ALTAs 2 and 5 were historically important areas for providing spawning and early rearing habitat for

subpopulations of resident cutthroat trout. Streams in these ALTAs were cold and inherently unproductive, providing habitat for which westslope cutthroat trout are ideally suited (Liknes and Graham, 1988). High elevation ALTA 2 and 5 complexes also provided stable stream environments due to an infrequent disturbance history. These areas also functioned as sources for refounding, given downstream disturbances in the breaklands landforms.

Periodic disturbances in both breakland streams and uplands, including stand-replacing fires, floods, and debris torrents, occurred frequently. Although local impacts to cutthroat trout probably occurred, populations recovered quickly as a result both of spawning and rearing areas upstream and the influx of fluvial adult spawners from the Selway River. Both functioned effectively to provide recruitment to populations adversely affected by such pulse events. Consequently, the cutthroat trout metapopulation in the Selway subbasin was inherently quite resistant and resilient to natural disturbances in the subbasin and apparently flourished despite regular catastrophic events.

In the Middle Fork Clearwater subbasin, Clear Creek provided some spawning and early rearing habitat despite the lack of high elevation glaciated lands. Other tributaries provided limited spawning and early rearing habitat. These streams have inherent low habitat capability for cutthroat trout due to size and accessibility. Fluvial cutthroat trout in the Middle Fork Clearwater River were part of the Selway and Lochsa metapopulations.

As previously discussed, key spawning and rearing areas for cutthroat trout were located in ALTAs 2 and 5, which, in addition to offering high-elevation stable habitats, were also located away from areas where concentrated spawning and rearing by anadromous fish occurred. Areas that historically supported key anadromous spawning and early rearing habitat included most of the lower reaches of the larger tributaries in the subbasin. Rieman and Apperson (1989) reported that where cutthroat trout and steelhead trout coexist naturally, the two species exhibit strong segregation. In streams where both species occur, Hansen (1977) found that cutthroat trout were restricted to headwater reaches while steelhead trout used the lower reaches, and suggested that a form of interactive segregation isolated the two species.

Conversely, Griffith (1988) believed that selective segregation is more important, observing that westslope cutthroat trout did not replace steelhead trout when the latter declined and disappeared following construction of Dworshak Dam. Goodnight and Mauser (1980) reported an increase in the proportion of cutthroat trout to rainbow trout following the elimination of steelhead trout in the Little North Fork Clearwater River, but did not note an overall increase in cutthroat numbers. The lack of increase in cutthroat trout with a decline in steelhead trout supports the idea of selective segregation and limited competition (Griffith, 1988).

Westslope cutthroat trout preceded the advent of anadromous fish over geologic time but co-evolved with bull trout (Behnke, 1992). Sympatric spawning and early rearing areas for bull trout and cutthroat trout were common in the Selway subbasin, whereas spawning and early rearing of cutthroat trout rarely occurred where the abundance of anadromous fish was high. The advent of anadromous fish may have subsequently pushed cutthroat trout to the upper reaches of tributary streams because of niche overlap and their proportionately greater fecundity.

Smaller tributaries to the Selway River were also contributors to spawning and early rearing habitat available to westslope cutthroat trout, but would not have been considered key areas with high habitat potential. The larger of these, however, may have supported small, isolated resident subpopulations. Most of these streams are located in ALTA 8, moist breaklands. Breakland streams flowing through ALTA 3 (low elevation granitic breaklands), located mostly upstream of Moose Creek, were also used for spawning and early rearing. Both of these ALTAs are prone to frequent disturbance events, and therefore subpopulation resilience was highly dependent on the influence of fluvial fish.

The Middle Fork Clearwater River and the Selway River from its mouth to the headwaters were used by adult fluvial cutthroat trout as a migration corridor, adult rearing, and overwinter habitat. In addition, the lower reaches of large tributaries functioned similarly. Due to the common occurrence of the accumulation of anchor ice in the mainstem Selway River during the winter, there is some evidence that cutthroat trout migrated to the lower reaches of large mainstem tributaries to overwinter.

Historic Distribution in Mountain Lakes: Due to isolation and impassible barriers, most high mountain lakes in the subbasins did not support fish. Several lakes may have historically supported westslope cutthroat trout, however. Cutthroat trout in these lakes were self-sustaining and may have moved freely between the stream and lake environments. Without exception, the outlets of these lakes are low gradient and lack significant barriers to upstream migration. Cutthroat trout in the lakes differed very little, if at all, from the rest of the fish in the upper reaches of these watersheds and constituted an important part of the subpopulation where they occurred. Cutthroat trout in lakes may have tended to overpopulate the lakes, resulting in large numbers of small adult fish.

Historic Genetic Integrity: Historically, fluvial adult cutthroat trout were found throughout the mainstem Selway and Middle Fork Clearwater Rivers. Prespawning adults migrated from the river to both large and small tributaries and spawned in the middle and upper reaches of most accessible suitable habitat. In addition, many tributaries supported isolated subpopulations of cutthroat trout, which were partly or completely isolated from the rest of the watershed. Some of these populations probably developed local adaptations as a result of their isolation and were genetically distinct from the rest of the cutthroat in the subbasin. The degree of divergence was probably correlated with temporal degree of isolation. Other subpopulations were periodically affected by wide-ranging fluvial fish, which contributed to the subpopulation's genetic composition. This contribution to the gene pool served to broaden the genetic diversity of these subpopulations, and increased both resistance to environmental change and resilience. Most cutthroat subpopulations supported both a resident and fluvial component, with the relative proportion of each correlated with accessibility to the mainstem. A combination of these two life history strategies served to insulate the species from extinction in an environment that was highly prone to natural disturbance.

In general, westslope cutthroat trout were reproductively isolated and genetically distinct from redband/steelhead trout. In some areas hybridization may have occurred, but on a limited basis. Key westslope cutthroat trout spawning areas were located outside of the range of anadromous fish, as discussed above.

Historic Watershed and Subpopulation Connectivity: Connectivity was high both within smaller tributary watersheds and between tributaries and the rivers, thereby providing for both fluvial and resident life history strategies and high variation in the genetic composition at both the subpopulation and metapopulation scales. Most large and moderate-size tributaries to the Selway River were accessible to westslope cutthroat trout in the river. Connectivity of subpopulations in the upper reaches of many watersheds may have been compromised by gradient, barriers, or distance to the rivers. Subpopulations in these upper reaches contributed to downstream genetic variation (through emigration), but were not subject to influence from spawning fish migrating upstream. Genetic divergence may have occurred where differences in selection pressures existed, which presumably included stochastic environmental events such as wildfires or floods, and different habitat conditions. Areas that potentially supported isolated and genetically distinct subpopulations included the headwaters of Gedney, North Fork Moose, Rhoda (tributary to North Fork Moose Creek), East Fork Moose, Paradise (tributary to Bear Creek), Pettibone, and White Cap Creeks.

Connectivity was somewhat compromised by the existence of Selway Falls, a very steep drop in the Selway River located just downstream from the mouth of Meadow Creek. It is possible that

westslope cutthroat trout in the upper portion of the subbasin were functionally isolated from cutthroat trout in lower portion, at least in terms of upstream migration. Although Selway Falls was passable at most flows by adult anadromous fish, passage by smaller cutthroat trout is uncertain. Upstream passage was probably impeded but not precluded.

Departure From Historic Conditions

Spawning and Early Rearing Areas: Currently, westslope cutthroat trout are distributed similarly to the way they were historically, with several notable departures. In some areas, habitat has been degraded by anthropogenic press disturbances on the landscape (mostly roads), which has resulted in decreased carrying capacity and a decline in the abundance of cutthroat trout. The watersheds affected in this way are largely located in the lower portions of the Selway subbasin and throughout the Middle Fork Clearwater subbasin. Although these affected streams continue to support cutthroat trout spawning and early rearing, numbers are depressed, and abundance is considerably less than it was historically.

More significantly, cutthroat trout have apparently been extirpated in other areas. Brook trout encroachment downstream from mountain lakes has occurred in several streams, and in most cases, areas where brook trout are established are devoid of cutthroat trout (USFS unpublished data, 1989-1999). Some of these areas include the upper reaches of Gedney, Three Links, East Fork Moose, Rhoda (tributary to North Fork Moose Creek), Pettibone, and Running Creeks. Brook trout encroachment has occurred in other areas, where brook trout coexist with cutthroat trout. These areas include Buck Lake Creek (Meadow Creek watershed), and Mink, O'Hara, and Clear Creeks.

Streams where brook trout are established appear to share similar characteristics. Without exception, these stream reaches are located in either ALTA 2 or ALTA 5, which were previously identified as supporting key spawning and early rearing habitat for cutthroat trout. Stream characteristics include moderate to low gradient channels, low stream temperature in the summer and, where gradients are higher, and abundance of plunge pools. Brook trout establishment does not appear to be correlated with stream order, substrate condition, or habitat complexity. Anadromous fish are also notably absent from areas where brook trout proliferate. Current distribution data suggest that brook trout are limited to areas where anadromous fish do not spawn and rear. It is unknown if the distribution of brook trout is currently changing or if it has reached equilibrium. Typically, brook trout are established as the only species downstream from their lake of origin and then are gradually replaced by cutthroat trout and steelhead/redband trout further down the watershed.

Areas which continue to function as key spawning and rearing areas for cutthroat trout include the upper reaches of Meadow, Marten, North Fork Moose, Bear, Ditch, White Cap, and Indian Creeks, the upper reaches of the Little Clearwater River, and also tributaries to the Selway River in the Selway Headwaters ERU. Populations in all these areas are comprised of both a resident and fluvial (migratory) component. Numerous resident subpopulations exist across the subbasin, some of which are functionally isolated from the rest of the subbasin.

Distribution in Mountain Lakes: Westslope cutthroat trout continue to exist in mountain lakes where they may have been historically indigenous, except for Moose Lake. The genetic integrity of cutthroat trout in lakes has likely been compromised by the introduction of Yellowstone cutthroat and/or rainbow trout in all lakes but one. Additionally, introduction of hatchery westslope cutthroat trout fry into mountain lakes may have affected the genetic integrity of indigenous westslope cutthroat trout.

Migration and Late Rearing: The Selway and Middle Fork Clearwater subbasins have inherently high capability to support migratory westslope cutthroat trout. Both rivers currently support significant numbers of adult fluvial fish. Current distribution of fish in terms of migration and late

rearing differs very little, if at all, from historic migration and late rearing. Angling and harvest have probably affected the abundance of large fluvial fish in both rivers.

Genetic Integrity: In general, genetic integrity has probably been reduced from historic levels, both from elimination of some isolated subpopulations by the encroachment of brook trout, and through potential introgression with non-native Yellowstone cutthroat and hatchery rainbow and westslope cutthroat trout. Loss and/or hybridization of locally adapted subpopulations may significantly affect the fitness of the metapopulation. Adaptive genetic divergence between adjacent subpopulations confers greater average fitness to the metapopulation by allowing each unit to respond to specific environmental conditions, which maximizes overall fitness in environments that are subject to change (Ford, 1956). Therefore, loss of subpopulations or unique adaptations through introgression may have decreased the resilience of the Selway metapopulation to environmental perturbation.

Watershed and Subpopulation Connectivity: Watershed connectivity within the Selway and Middle Fork Clearwater subbasins is similar to its historic condition. Exceptions to this are rare, and are generally associated with road crossings of streams where fish passage is precluded or impeded by culverts.

Population Dynamics and Viability: Current conditions are similar to historic conditions, except for the loss of subpopulations at the headwaters of Gedney, Three Links, Rhoda, Running, and East Fork Moose Creeks due to the encroachment of brook trout. The risk of extinction for remaining subpopulations from stochastic environmental events such as wildfire or floods is highly unlikely, given that westslope cutthroat trout evolved with these types of events and are quite resilient (Rieman and Apperson, 1989). Environmental stochasticity includes random variation in mortality and birth rates driven by environmental variations (Ginzburg et al., 1990; Leigh, 1981; Shaffer, 1991). Habitat in the Selway subbasin has sustained few press impacts and retains its ability to recover rapidly from natural events. In addition, habitat connectivity is high, and subpopulation recovery is a certainty from refounding by fish from other areas. The existence of numerous interconnected healthy subpopulations in addition to an intact fluvial component of this metapopulation virtually ensures its existence through time despite the loss of several subpopulations.

Therefore, the risk of additional subpopulation and metapopulation extinction is low given current conditions. This risk could change, however, with additional introduction of brook trout to key cutthroat trout areas, a change in fishing regulations, increased human access, or widespread application of press sediment impacts in key spawning and early rearing areas.

Key Factors and Threats to Westslope Cutthroat Trout

Key factors and threats affecting westslope cutthroat trout identified in the *ICBEMP Component Report*, which are applicable to cutthroat trout in the Selway and Middle Fork Clearwater subbasins, are included below.

Introduced Species: Impacts from introduced species on westslope cutthroat trout in the Selway and Middle Fork Clearwater subbasins are primarily associated with brook trout encroachment downstream from mountain lakes where they were stocked in the 1930s. Where brook trout are strongly established, westslope cutthroat trout are not present. Areas where this has occurred probably provided historic key spawning and early rearing habitat.

Stocking of hatchery Yellowstone cutthroat trout, rainbow trout, and westslope cutthroat trout may have resulted in loss of genetic integrity of locally adapted westslope cutthroat trout subpopulations. In the Selway subbasin, westslope cutthroat trout co-evolved with steelhead/redband trout. Although hybridization is possible, westslope cutthroat trout and steelhead/redband trout are reproductively isolated based on distribution in the subbasin and

disparate spawning periods. Hybridization with hatchery rainbow trout stocked in high mountain lakes, however, may have occurred.

Angling: As previously mentioned, angling in the mainstem Selway and Middle Fork Clearwater Rivers probably affects the fluvial component of the cutthroat population, particularly in the Middle Fork Clearwater River and the Selway River below Selway Falls. Both of these areas are readily accessible by anglers, and fishing pressure is generally moderate. Upstream of Selway Falls, the State of Idaho has imposed catch-and-release regulations for all trout, which started in 1976. Following the inception of this regulation, cutthroat trout numbers and mean size increased significantly, suggesting a strong response to this restriction and a significant impact from angling prior to the regulation change (Lindland, 1979). Illegal harvest of cutthroat trout in the Selway River, both above and below Selway Falls, is probably widespread, however. The Middle Fork Clearwater and Selway Rivers both provide anglers with opportunities to catch fish greater than 300 mm in length. Many people visit the area specifically to fish.

Harvest in Selway River tributaries is limited to two trout per day. This limit is probably regularly exceeded in the wilderness and roadless portions of the subbasin. Due to a perceived low risk of detection, a seemingly limitless fishery resource, and a subsistence attitude toward fish and wildlife by many wilderness visitors, many anglers forego regulations (K. Thompson, personal observations). Although prevalent, this harvest generally does not pose a risk to the persistence of cutthroat in the subbasin. Should access change or numbers of anglers significantly increase, angling mortality could have a significant effect.

Summary of Westslope Cutthroat Trout Habitat and Population Status

Map 27 displays the habitat and population status for westslope cutthroat trout. The following ERUs and sub-ERUs are classified as strongholds: Otter and Mink, lower Moose Creek, upper Moose Creek, Ditch Creek, upper Pettibone and Bear, lower Running and Goat, upper White Cap, Indian Creek, and the lower Little Clearwater River in the Selway Headwaters ERU. ERUs or sub-ERUs categorized as stronghold watersheds comprise 42 percent of all ERUs and sub-ERUs in the Selway and Middle Fork Clearwater subbasins. It should be noted that within some of the above-mentioned areas, brook trout have encroached into portions of these watersheds and eliminated cutthroat trout. Such brook trout areas within the above mentioned ERUs include Rhoda Creek and East Fork Moose Creek in the Moose Creek ERU, and Pettibone Creek in the Pettibone and Bear ERU. Each of these areas constitutes a small percentage of the overall ERU, however.

ERUs and sub-ERUs classified as habitat strongholds, which indicate in most cases historic key spawning and rearing areas where cutthroat trout have been replaced by brook trout, include the following ERUs and sub-ERUs: lower Meadow Creek, Gedney and Three Links, and upper Running and Goat. There is one historic stronghold, which is O'Hara Creek.

BULL TROUT (*Salvelinus confluentus*)

The U.S. Fish and Wildlife Service listed bull trout as a threatened species under the Endangered Species Act in 1998, and the state of Idaho considers bull trout a species of special concern. The American Fisheries Society has also recognized the bull trout as a species of special concern. The state of Idaho has developed a bull trout conservation plan, with the stated mission to "maintain and/or restore complex interacting groups of bull trout populations throughout their native range in Idaho" (Idaho, 1996).

The historic range of bull trout included most of the Columbia River basin. Current bull trout range includes about 44 percent of the estimated historic range, with the core of the remaining bull trout distribution in the central Idaho mountains, including the Clearwater basin (Quigley et al., 1997).

Basin Context

Bull trout in the subbasins are part of the Columbia River ecologically significant unit (ESU). The U.S. Fish and Wildlife Service has listed bull trout in this ESU as a threatened species under the Endangered Species Act. The Selway subbasin represents an important metapopulation of bull trout within the Snake River. The State of Idaho has identified the Selway subbasin as a key watershed for bull trout in its *Bull Trout Conservation Plan*.

Both the Lochsa and Selway Rivers are considered refuges in the Clearwater subbasin, given their location, accessibility, high-quality habitat, connectivity among subpopulations, and number of roadless and wilderness tributaries which lack press sediment effects caused by establishment of permanent sediment-producing features. Although these watersheds are prone to natural pulse sediment events, there are enough of them to function as refuge streams in the event that other streams are impacted by such natural events.

Historic Conditions Related to Bull Trout

Inherent Habitat Capability and Population Dynamics: The Selway and Middle Fork Clearwater subbasins have high to very high inherent capability to support bull trout. The Selway portion has been identified as supporting a known and predicted strong population of bull trout in the upper Columbia basin (Quigley et al., 1997). Habitat capability is discussed in this section as it relates to: (1) the habitat capability of the subbasin to support bull trout spawning and rearing (early rearing for migratory fish); (2) the subbasin's capability to support migration and late rearing of fluvial fish (adult/subadult rearing); and (3) the subbasin's capability to support a metapopulation, or connection of local populations, of bull trout.

Historic spawning and early rearing habitat for bull trout in the Selway subbasin probably included the middle and upper reaches of many of the larger mainstem tributaries. These streams included Gedney, Meadow, Three Links, Marten, Moose (as well as North Fork Moose, Rhoda, and East Fork Moose), Bear, White Cap, Indian, Swet, and Wilkerson Creeks, the Little Clearwater River, and the upper reaches of the Selway River. The high elevation complexes found in the upper reaches of these streams provided inherently stable environments and stream conditions for bull trout spawning and early rearing due to the low disturbance frequency. Resident bull trout populations were located in the upper reaches of most of these tributaries, while fluvial bull trout used the middle reaches for spawning and rearing. Resident populations not isolated from the mainstem by migration barriers were composed of a fluvial component even if the primary life history strategy was resident.

The higher elevation complex of ALTAs, which include ALTAs 1, 2, and 4, found in the upper reaches of the above-named streams, provide inherently stable environments, cold stream temperatures, and streams of low to moderate gradient. This complex of ALTAs provides a very high habitat potential for bull trout. The productivity of these areas varies, ranging from low to moderately high

Low elevation breaklands, of which most of the lower reaches of tributaries are composed, do not have inherently high capability for bull trout spawning and early rearing and probably were not historically important for spawning and rearing. These areas almost exclusively are composed of ALTAs 8, 3, and 7. Streams in these ALTAs are subject to more frequent disturbances, higher stream temperatures, and less stable temperature regimes during the spawning period. These reaches were important, however, for adult rearing and migration.

Historically, bull trout spawning and rearing areas occurred in sympatry with westslope cutthroat subpopulations. These two species probably co-evolved and represent an example of niche segregation, where cutthroat trout provide a food source for bull trout, but the two species do not directly compete for space or other resources.

In the Middle Fork Clearwater subbasin, Clear Creek probably provided some spawning and rearing habitat, but is not considered an historic stronghold watershed. The Middle Fork Clearwater River functioned as an important migration corridor, connecting bull trout populations in the mainstem/North Fork Clearwater River, South Fork Clearwater River, and Lochsa River to the Selway population. The river also provided important overwintering habitat, and anadromous smolts migrating downstream in the spring probably served as an important food source.

Historic Connectivity: Connectivity in the Selway and Middle Fork Clearwater subbasins was high both within smaller tributary watersheds and between tributaries and the rivers, thereby providing for both fluvial and resident life history strategies and high variation in the genetic composition at both the subpopulation and metapopulation scales. Most large and moderate-size tributaries to the Selway River were important to bull trout in the river. Gradient, barriers, or distance to the river may have compromised connectivity of subpopulations in the upper reaches of many watersheds. Subpopulations in these areas contributed to downstream genetic variation (through emigration) but were not subject to influence from spawning fish migrating upstream. Streams which supported functionally isolated resident subpopulations of bull trout included Meadow, Running, and Wilkerson Creeks.

Connectivity between the upper and lower portions of the subbasins was somewhat compromised by the existence of Selway Falls, a very steep drop in the Selway River located just downstream from the mouth of Meadow Creek. Since there were no stronghold watersheds below Selway Falls in the Selway subbasin, Selway Falls as a migration barrier was more significant at the basin scale, as it potentially isolated bull trout in the Selway River from other populations in the Clearwater basin. Selway Falls, however, probably impeded upstream migration of bull trout but did not preclude it. Bull trout in the Selway River were therefore not functionally isolated from those in the rest of the Clearwater basin.

Departure From Historic Conditions

Habitat Capability and Population Dynamics: Review of the distribution of bull trout across the various ALTAs in the Selway and Middle Fork Clearwater subbasins suggests a rough correlation between ALTA 1 (broad convex ridges, high elevation, granitic) and occurrence of spawning and early rearing. Landtypes in ALTA 1 are located above 5,500 feet elevation and are dominantly low relief, with mostly low or moderate gradient small streams. Streams flowing through this ALTA include the upper reaches of Meadow Creek, Eagle and Lynx Creeks (tributaries of Running Creek), Deep Creek, the Little Clearwater River, and Wilkerson, Surprise, and Hells Half Acre Creeks. All these areas support bull trout spawning and early rearing.

The largest known concentration of fluvial spawning and early rearing is located in Wounded Doe Creek, which does not include any lands classified as ALTA 1, but does include extensive lands classified as ALTA 2 and 5 (glaciated slopes and glaciated valley bottoms, high elevation, granitic). It would appear, then, that ALTAs 2 and 5 are also important where streams meet other important criteria, such as low to moderate stream gradient and stable stream temperatures during spawning. There are a number of other streams with significant inclusions of ALTA 2 and 5 which do not currently support bull trout spawning and rearing, however, including Bear, Three Links, Gedney, Goat, East Fork Moose, Pettibone, and the upper reaches of North Fork Moose Creek (outside of the Rhoda and Wounded Doe watershed). Of these, Gedney, Pettibone, East Fork Moose, and Three Links Creeks have been colonized by brook trout, which would have effectively eliminated any bull trout populations. The upper reaches of North Fork Moose Creek and Goat Creek may be inaccessible to bull trout because of impassible barriers. The reason for the absence of spawning and early rearing of bull trout in Bear Creek is unknown. Bull trout may occur in Cub and Paradise Creeks, however, which have never been surveyed comprehensively for this species. This lack of information is considered a data gap. The occasional large fluvial bull trout has been observed in the lower reaches of Bear Creek.

Clear Creek and O'Hara Creek have been significantly affected by land management activities. Gedney, Three Links, North Fork Moose, and East Fork Moose Creeks have been impacted by encroachment of non-native brook trout stocked in high mountain lakes. In addition, habitat capability for bull trout in Gedney Creek may have been affected by debris jam removal efforts, which occurred in the 1960s.

Streams or areas described as existing strongholds are displayed on Map 28. These include Wounded Doe Creek, the upper reaches of Meadow Creek, Lynx Creek (a tributary of Running Creek), the Little Clearwater River, White Cap Creek, Deep Creek, and most of the larger order streams in the Selway Headwaters ERU, including the mainstem of the Selway itself. All these areas support early rearing and spawning habitat for fluvial and/or resident bull trout, and strong populations of bull trout currently exist in these areas.

Currently, both the mainstem Selway and Middle Fork Clearwater Rivers function as migration corridors and overwintering habitat for bull trout. In addition, the lower reaches of larger mainstem tributaries may function similarly. Habitat potential for bull trout has been reduced in specific areas, but overall the Selway River currently provides habitat similar to historic conditions.

Viability: Bull trout in the Selway subbasin are believed to represent a functional metapopulation of bull trout that is influenced by migration of other bull trout from interconnected areas. Historically, individuals in this metapopulation were distributed throughout the high potential spawning and early rearing areas, as well as in the main river itself, which provided important migratory and adult rearing habitat. Currently, habitat integrity and connectivity are similar to their historic conditions, and bull trout continue to spawn and rear in these areas.

Extinction risk of bull trout in the Selway subbasin is currently low.

Connectivity: Watershed connectivity within the Selway and Middle Fork Clearwater subbasins is similar to its historic condition. Exceptions to this are rare and are associated with road crossings of streams where passage is precluded or impeded by culverts. Culverts across Boyd and Cache Creeks, both tributaries to the Selway River below Selway Falls, block or impede fish passage into these streams. A culvert near the mouth of Swiftwater Creek impeded fish passage for decades before it was replaced in the past 10 years. None of these streams currently support bull trout.

Key Factors and Threats to Bull Trout

Key factors and threats affecting bull trout identified in the *Interior Columbia River Basin Component Report* that are applicable to bull trout in the Selway and Middle Fork Clearwater subbasins are included below.

Harvest of Adults: Harvest of adult bull trout in the Selway subbasin has been identified as a key factor and a threat. Although harvest of bull trout is not legal under current state fishing regulations, illegal harvest occurs both in the roaded portions of the subbasin and in wilderness portions. In the wilderness and unroaded portions of the subbasin, low presence of law enforcement personnel, assumed low risk of detection due to the remoteness of the area, seemingly limitless fishery resources, and a shift in attitude from fishing as a sport to fishing as subsistence all contribute to illegal harvest of bull trout in wilderness.

Introduced Species: Brook trout were introduced into the streams and lakes of the Selway and Middle Fork Clearwater subbasins in the 1930s and 1940s. Although brook trout are no longer stocked, they exist in self-sustaining populations in many lakes and streams in Clear Creek and throughout the Selway subbasin. In general, brook trout are considered a threat to bull trout in the Selway subbasin, and their presence may have resulted in extirpation of some subpopulations. Streams where this may have occurred include the upper reaches of Gedney, Running, Rhoda, Three Links, Pettibone, and East Fork Moose Creeks.

Brook trout serve as a threat to bull trout through competitive displacement and loss of genetic integrity through interbreeding and production of sterile hybrid offspring.

Summary of Bull Trout Habitat and Population Status

Map 28 displays the habitat and population status for bull trout. The following ERUs, sub-ERUs, or individual sixth-code watersheds are classified as strongholds: upper Meadow Creek ERU, Wounded Doe Creek (in Moose Creek ERU), Lynx Creek (in Running and Goat ERU), Canyon Creek (in White Cap ERU), the Little Clearwater River, Deep Creek, and the larger streams in the Selway Headwaters ERU.

Habitat strongholds include Gedney Creek, Three Links Creek, Rhoda Creek, and Running Creek.

STEELHEAD/REDBAND TROUT (*Oncorhynchus mykiss*)

The National Marine Fisheries Service listed Columbia and Snake River steelhead trout of wild or natural origin as threatened under the Endangered Species Act in 1997. Numerous state, federal, and provincial management agencies list steelhead as a species of special concern.

The following information is summarized from the *Interior Columbia River Basin Component Report* (1997). Steelhead trout, the anadromous form of redband trout in Idaho, are distributed within the upper Columbia River basin as two genetically distinct subspecies, which include coastal and inland. Each subspecies has two major forms, winter and summer, although coastal steelhead are predominately winter-run and inland steelhead summer-run.

Redband trout, which are the resident form of steelhead trout in the upper Columbia Basin, have been further divided into two groups, one group which evolved in sympatry with steelhead and the other allopatric with steelhead, or those which evolved outside the historical range of steelhead. Sympatric redband trout are considered the non-anadromous form historically derived from or associated with steelhead and have been termed "residuals." Both anadromous and non-anadromous forms exist in sympatry in most populations, and morphologically juveniles of both forms are generally indistinguishable.

The distribution and abundance of wild steelhead trout have declined from historical levels as a result of passage mortality at dams and obstructions, habitat degradation, loss of access to historical habitat, over-harvest, and interactions with hatchery-reared and non-native fishes. Concern for the persistence of wild steelhead stocks culminated in 1994 with petitions to the National Marine Fisheries Service for review of the species' status under the Endangered Species Act. Columbia and Snake River steelhead trout of wild or natural origin were subsequently listed as a threatened species in September 1997.

The historical range of steelhead trout was the eastern Pacific Ocean and fresh waters west of the Rocky Mountains, extending from northwest Mexico to Alaska (Scott and Crossman, 1973). In the Columbia River basin, steelhead trout were present in most streams, both perennial and intermittent, that were accessible to anadromous fish, including all accessible tributaries to the Snake River downstream from Shoshone Falls (Parkhurst, 1950).

Steelhead trout are currently the most widely distributed anadromous salmonid in the Interior Columbia River Basin assessment area, although they are extinct in large portions of their historical range. The current known distribution includes 46 percent of their historical range. About 7,720 miles (12,452 km) of historical range is no longer accessible in the Columbia River basin in the United States and Canada (Northwest Power Planning Council, 1986).

Despite their relatively broad distribution, very few healthy wild steelhead populations exist (Quigley et al., 1997). Recent status evaluations suggest many steelhead populations are depressed. A recent multi-agency review showed that total escapement of salmon and steelhead

to the various Columbia River regions has been in decline since 1986 (Anderson et al., 1996). Existing steelhead stocks consist of four main types: wild, natural (non-indigenous progeny spawning naturally), hatchery, and mixes of natural and hatchery fish. Production of wild anadromous fish in the Columbia River basin has declined about 95 percent from historical levels (Huntington et al., 1994).

Basin Context:

Steelhead trout in the Selway and Middle Fork Clearwater subbasins are part of the Snake River ecologically significant unit (ESU) of west coast steelhead and as such are currently listed as threatened under the Endangered Species Act (ESA) by the National Marine Fisheries Service (NMFS). Steelhead trout have also been considered a species of special concern by the State of Idaho and a sensitive species by Region 1 of the U.S. Forest Service. Steelhead trout in the Selway subbasin represent an important metapopulation in the Clearwater basin. This stock is of particular interest and value because it has never been supplemented with hatchery steelhead. The Middle Fork Clearwater River functions primarily as a migration corridor for upstream migrating adult fish and downstream migrating smolts. It may also provide overwintering habitat for juveniles. In addition, Clear Creek provides significant spawning and early rearing habitat, while smaller tributaries to the Middle Fork Clearwater provide moderate to low spawning and rearing habitat.

Historic Conditions Related to Steelhead/Redband Trout

Inherent Habitat Capability and Historic Population Dynamics: The Middle Fork Clearwater subbasin has high inherent capability to support steelhead trout, while the Selway subbasin has very high capability to support this species. This assertion is based on general features such as climate, elevation, relief, geology, and the size, configuration, and accessibility of the river and its tributaries. Habitat capability is discussed in this section as it relates to: (1) the capability of the subbasins to support steelhead trout spawning and rearing; and (2) the Selway and Middle Fork Clearwater Rivers' capability to support migration.

Historic key spawning and early rearing areas for steelhead trout in the Selway and Middle Fork Clearwater sub basins included the middle and lower reaches of the larger main stem tributaries, including Clear, O'Hara, Gender, Meadow, Three Links, Marten, East Fork Moose, North Fork Moose, Petitioner, Bear, Paradise, Cub, White Cap, Running, Indian, and Deep Creeks, the Little Clearwater River, and the main stem Selway River and tributaries in the Selway Headwaters ECRU. In addition, all of the accessible, moderate-sized break lands tributaries to the Selway River supported spawning and early rearing of this species. Most key spawning and early rearing areas were located within ALTAs 3 and 8, which include low elevation, granitic breaklands and moist, metamorphic breaklands, respectively. These ALTAs historically provided the most abundant and significant spawning and early rearing habitat for steelhead trout. Streams were moderate gradient with moderate valley confinement and high energy, providing abundant spawning gravels and pocket water preferred by juvenile steelhead.

Although ALTAs 3 and 8 were subject to frequent disturbances and alteration of stream habitat, given widespread availability of habitat and high fecundity of this species, steelhead were well-adapted to function under frequent disturbance regimes. Local impacts to specific year-classes may have occurred, but given the overall availability of optimum habitat, the loss of a single year-class in any of the above tributaries from a catastrophic event was easily absorbed by the high success in other unaffected tributaries. Given high fecundity and their anadromous life history strategy, steelhead trout were inherently quite resistant and resilient to environmental perturbation, despite their apparent affinity for streams subject to frequent disturbance.

Within all steelhead trout subpopulations in the Selway subbasin, a percentage of fish adopted a resident life history strategy and remained in the natal stream or the Selway River. Both anadromous and resident forms are classified as "redband trout" in the interior Columbia River

basin (Behnke, 1992). The combination of anadromous and resident life history strategies ensured the perpetuation of the species in the event of poor adult returns. Normally anadromous fish would dominate the total numbers found in any system, due to their much higher fecundity, but in years where adult returns were low, the resident forms virtually guaranteed the future persistence of redband trout.

In the Middle Fork Clearwater subbasin, Clear Creek supported key spawning and rearing areas in its lower two thirds, most of which is located in ALTA 7, which includes low elevation basalt breaklands. In addition, Suttler and Swan Creeks supported some spawning and early rearing. Other tributaries, most of which were second to third order streams, were steep and accessible to fish only in their lower reaches. These streams provided limited rearing habitat for steelhead that was important in providing thermal refuge to juveniles in the Middle Fork Clearwater River during late summer and fall. These streams are mostly located in ALTAs 15 and 7. ALTA 15 includes mid-elevation basalt plateaus located in the western portion of the assessment area.

Historic Connectivity: Historic connectivity of subpopulations of both steelhead trout and resident redband trout was high. Selway Falls constituted a partial barrier to upstream fish migration during certain flow levels, including both peak flows in the spring of many years and summer low flows. Timing of adult migration and spawning was such that adults were able to migrate through Selway Falls at optimal flow levels. Historically, adults staged below the falls and then migrated through when flows were optimal, usually in May. Access to Selway tributaries occurred at moderate and high flows, with elevation of the river and discharge of tributaries allowing access to the lower reaches of most streams. Available, accessible habitat was used for spawning, with fish concentrating on the upper, middle, and lower reaches of large streams where accessible, and the lower reaches of small streams. Early rearing occurred where summer low flows allowed, otherwise fry and juveniles migrated downstream to the river where they reared or migrated to larger tributaries.

Departure From Historic Conditions

Habitat Capability and Population Dynamics: Currently, steelhead trout are distributed similarly to the historic condition in the Selway and Middle Fork Clearwater subbasins. There are no known streams where steelhead trout have been extirpated as a result of anthropogenic activity. Abundance of steelhead trout, however, has declined significantly from historic levels. In watersheds affected by road construction and other press disturbances, carrying capacity is probably reduced. ERUs where this has occurred include Clear Creek, Middle Fork Clearwater Face, North Selway Face, O'Hara and Goddard, Running and Goat, Meadow Creek, and Deep Creek. In general, habitat in the Selway subbasin retains its inherent high capability to support and produce steelhead trout, especially in historic key spawning and rearing areas identified above in the Inherent Habitat Capability and Historic Population Dynamics section.

Current key steelhead trout spawning and rearing areas include mainstem Meadow Creek from its mouth upstream through the breaklands ALTAs, the lower half of mainstem Marten Creek, North Fork Moose Creek, the lower reaches of Bear Creek (including lower Paradise, Cub, and Brushy Fork Creeks), lower Running Creek, White Cap Creek, the Little Clearwater River, and most streams in the Selway Headwaters ERU. The Selway River system is recognized as supporting one of the last remaining populations of B-run summer steelhead in Idaho that have not been supplemented with hatchery-produced steelhead. B-run steelhead are those which pass over Bonneville Dam later than other Snake River steelhead. Declines of B-run steelhead, including those returning to the Selway River, are well documented and have culminated with the species listed as threatened in 1997.

Resident redband trout appear to comprise a significant portion of at least several steelhead/redband subpopulations in the Selway subbasin (Huntington, 1997; USDA unpublished data, 1997-1998). Stream survey data and anecdotal observations suggest that North Fork Moose Creek and Meadow Creek support a significant resident component, where resident fish

are physically distinct from anadromous pre-smolts, even where sizes overlap. It is possible that a measure of divergence and reproductive isolation has occurred between both forms, and with the decline in anadromous fish returns over the past decades, this divergence has intensified because resident fish are more likely to be reproductively successful and more likely to breed with each other than with adult steelhead. If returns of adult steelhead continue to decline, a resident life history strategy may become the optimal strategy in terms of probability of reaching reproductive age, and the proportion of resident fish in this population may thus increase dramatically. This change would represent a significant departure from the historic condition.

Current habitat capability is generally similar to its historic condition, but some streams have sustained significant press disturbances, and instream habitat is currently degraded. Streams where this has occurred include Clear, O'Hara, Elk City, Goddard, Island, Falls, SOB, and Deep Creeks. Of these, degradation of O'Hara and Clear Creeks is most significant, since these streams provided historic key spawning and early rearing habitat. In addition, fire suppression may have increased the interval of pulse disturbances related to wildfires in ALTAs 3 and 8. Although cessation of pulse disturbances from wildfires may be related to the current high habitat capability in wilderness watersheds, decreases in fire frequency may result in more significant impacts to streams when wildfires eventually occur, due to higher severity. This is a significant departure from the historic condition, and is important for steelhead trout because most of their key spawning and rearing habitat is located in the breaklands ALTAs.

Connectivity: Current connectivity of habitat and subpopulations remains similar to its historic condition, with some exceptions. Most notably, access above Selway Falls has been improved from construction of the Selway Falls fishway, a tunnel that was blasted out of bedrock in the early 1960s. This structure is currently in place and is used by adult migrating steelhead trout. Most tributaries to the Selway River remain accessible to steelhead.

Access into Clear Creek is impeded by the existence of the Clear Creek hatchery weir, located near the mouth of Clear Creek. Some adult hatchery steelhead trout may be collected by this facility, which is operated by the U.S. Fish and Wildlife Service, primarily for the propagation of spring chinook salmon.

Key Factors and Threats to Steelhead/Redband Trout

Key factors and threats to steelhead trout identified in the *ICBEMP Component Report* that are applicable to steelhead trout in the Selway and Middle Fork Clearwater subbasins are included below. The primary threat to the persistence of steelhead trout in the Selway and Middle Fork Clearwater subbasins, however, is probably downstream mortality. Downstream effects include predation and competition by non-native species, blocked access to historical habitat, and dam passage mortality. The effect of these on the recovery of steelhead trout is proportionately much greater than the effects listed below in the Selway and Middle Fork Clearwater subbasins.

Habitat Degradation: Principal factors related to habitat degradation in the Selway and Middle Fork Clearwater subbasins are associated with excess fine sediment deposition in some watersheds from human-caused press disturbances on highly erosive landtypes, which has resulted in a base sediment yield higher than natural, or historic, base sediment yields.

Watersheds most affected by press sediment impacts include most streams in the Middle Fork Clearwater Face ERU, Clear Creek, most streams in the O'Hara and Goddard ERU (including O'Hara, Goddard, Elk City, Island, Falls, and SOB Creeks), and streams in the Deep Creek ERU. In addition, some streams have been affected by changes in channel morphology from past logging (where logs were skidded down stream channels), past channelization, past removal of debris jams, and domestic livestock grazing. These streams include Nineteenmile Creek (past channelization), Boyd Creek (past log skidding, debris removal, domestic livestock grazing), Glover Creek (past log skidding, debris removal, domestic livestock grazing), Gedney Creek (past debris removal), and the upper reaches of Meadow Creek (domestic livestock grazing).

Harvest: Harvest of wild steelhead trout in the Selway and Middle Fork Clearwater subbasins involves three principal components. The first is the sport harvest of adult steelhead trout in the Clearwater River downstream of the subbasins. This harvest includes incidental catch and illegal harvest of adult wild steelhead trout in a sport fishery where harvest of hatchery steelhead is permitted. Although most anglers comply with legal harvest requirements, a percentage of wild adults are killed each year through incidental hooking mortality or illegal harvest.

The second harvest component involves the legal harvest of pre-smolts in tributaries to the Selway River, particularly in Meadow Creek and tributaries below Selway Falls, which are accessible by roads. Most anglers perceive pre-smolts as resident rainbow trout. Harvest of two "trout" of any size after July 1 is legal under current state fishing regulations. Although not widespread, harvest of juvenile steelhead may be significant in certain areas, especially O'Hara Creek, where a popular campground is located near the mouth and a streamside road extends up the creek six miles.

The third component of harvest involves the capture of adult steelhead trout in the Selway Falls fishway for hatchery broodstock augmentation and research purposes. In recent years, forty or more adults have been removed. The significance of this activity to the wild Selway population is unknown. Although it may contribute to the recovery of steelhead trout outside the Selway subbasin, it does not contribute to the long-term persistence of steelhead trout within the subbasin.

Summary of Steelhead/Redband Trout Habitat and Population Status

Map 26 displays information on the habitat and population status for steelhead. The following ERUs, sub-ERUs, or individual sixth-code watersheds are classified as strongholds: lower Meadow Creek ERU, Buck Lake Creek, Gedney and Three Links ERU, Moose Creek ERU, lower Pettibone and Bear Creeks, upper Pettibone and Bear Creeks, Lower Running and Goat Creeks, lower Marten Creek, White Cap ERU, Indian Creek ERU, the Little Clearwater River, and streams in the Selway Headwaters ERU.

Clear Creek and O'Hara Creek are classified as historic strongholds, where habitat has been degraded and population numbers are depressed. Upper Meadow Creek is classified as a population stronghold, especially for redband trout, because population numbers are good but habitat has been degraded.

SPRING CHINOOK SALMON (*Oncorhynchus tshawytscha*)

Spring chinook salmon in the Clearwater basin are considered a sensitive species by the U. S. Forest Service Northern Region, and are considered a species of special concern by the state of Idaho. The species' Endangered Species Act status is discussed below.

The following information was summarized from the *ICRB Aquatic Component Report*. Chinook salmon are distributed widely throughout the Columbia River basin. Spring chinook salmon, which are the salmon found in the Selway and Middle Fork Clearwater subbasins, cross Bonneville Dam on the Columbia River from March through May. Spring chinook salmon in the Snake River basin are known as "stream type" chinook, along with summer chinook, and are more widely distributed than "ocean type," or fall chinook. Stream type chinook salmon are characterized by juveniles that migrate to the ocean as yearlings, while ocean-type chinook juveniles migrate to the ocean as subyearlings.

SNAKE RIVER chinook salmon (stream and ocean types) were listed as threatened under the Endangered Species Act in 1992. Spring chinook salmon in the Clearwater River basin were exempted from the listing because of uncertainty associated with the genetic integrity of this stock. Genetic integrity was questioned because the construction of Lewiston Dam in the early 1900s allegedly eliminated all runs of native spring chinook salmon into the Clearwater basin, and

those currently found in the basin are derived from subsequent planting efforts following removal of this dam.

The distribution and abundance of chinook salmon in the Columbia River have declined substantially from historic levels as a result of passage mortality at dams, habitat degradation, loss of access to historical habitat, overharvest, and interactions with hatchery-reared and non-native fishes. Historic runs of chinook salmon in the Columbia River were immense; estimates of annual run sizes prior to 1850 range from 3.4 to 6.4 million fish (Northwest Power Planning Council, 1986). About 7,720 miles (12,452 km) of the historical range in the United States and Canada are no longer accessible to chinook salmon. Chinook salmon are extinct in many areas of their historic range, including the Upper Klamath, Hood, Klickitat, Umatilla, Walla Walla, Entiat, and Yakima River basins, and the Metolius River above the Pelton and Round Butte Dams.

Basin Context

Spring chinook salmon in the Snake River are considered an ecologically significant unit (ESU). Spring chinook salmon in the Selway and Middle Fork Clearwater subbasins are not considered part of this ESU, however, because it is believed that the indigenous spring chinook populations were eliminated from the Clearwater River basin by construction of Lewiston Dam. Spring chinook salmon in the Clearwater River basin are therefore not listed as threatened under the Endangered Species Act as are other Snake River salmon, despite concurrent declines in the number of returning adults. Spring chinook salmon in the Selway and Middle Fork Clearwater subbasins represent an important metapopulation in the Clearwater River basin. Others occur in the Lochsa and South Fork Clearwater Rivers and in various tributaries to the lower Clearwater River.

Historic Conditions Related to Spring Chinook Salmon

Inherent Habitat Capability and Population Dynamics: The Selway and Middle Fork Clearwater subbasins have inherently high capability to support spring chinook salmon, especially in the larger mainstem tributaries to the Selway River, including Meadow, Moose, Bear, White Cap, and Running Creeks. This is based on features such as climate, elevation, relief, and geology. Habitat capability is discussed in this section as it relates to: (1) the capability of the subbasin to support spring chinook salmon spawning and rearing; and (2) the subbasin's capability to support juvenile and adult migration.

The Middle Fork Clearwater subbasin provided key migration habitat for adult salmon and migration and overwintering habitat for juvenile salmon. Clear Creek additionally provided spawning and early rearing habitat and was a historic stronghold. Other tributaries to the Middle Fork Clearwater River may have incidentally provided spawning and early rearing, but are not considered key habitats.

The Selway River supported significant returns of adult spring chinook salmon. Historic spawning and early rearing areas in the Selway subbasin included the lower reaches of the larger mainstem tributaries and the Selway River itself. Streams flowing through the low elevation breaklands, particularly those including and upstream of Moose Creek, provided key spawning and early rearing habitat. Of all the streams in the subbasin, Bear Creek probably supported the highest concentration of spawning adult salmon of any area. Adult salmon staged in deep pools below the mouth of Cub Creek. Large, contiguous beds of appropriately sized gravels provided abundant spawning habitat for this species. In these reaches, Bear Creek meandered across a relatively wide, low-elevation glacial valley bottom, which was moderately to heavily forested. Additional spawning and rearing areas were located above these reaches in both Bear and Cub Creeks. Both streams supported large amounts of instream debris recruited from adjacent cedar stands, which were stable and provided highly complex habitats.

Other areas in the subbasin providing key spawning and rearing habitat included the lower reaches of Moose Creek, North Fork Moose Creek, East Fork Moose Creek, the lower reaches of

Running Creek, the lower reaches of White Cap Creek, and the Selway River from the mouth of Moose Creek upstream to and including the mainstem in the Selway Headwaters ERU. Although most of the areas are located within the breaklands ALTAs and were thus subject to periodic disturbances, the species persisted over a wide range of conditions. Spring chinook salmon were highly resistant to pulse environmental perturbation, probably due their proportionately high fecundity and widespread availability of habitat.

Historic Connectivity: Historic connectivity in Clear Creek and the Selway subbasin was high. Selway Falls provided an impediment to upstream adult migration, but salmon generally migrated through in June and early July when flows were high enough to provide passage. In general, key spawning and early rearing areas were readily accessible to salmon at all flow levels and were not a significant determinant of salmon distribution.

Departure From Historic Conditions

Habitat Capability and Population Dynamics: Currently, spring chinook salmon are distributed similarly to the way they were historically. Salmon found in the Selway and Middle Fork Clearwater subbasins are not of the original stock that existed historically; however, they are all derived from salmon introduced in the mid-1900s following the removal of Lewiston Dam in the 1930s. Despite decades of extensive reintroduction and hatchery supplementation, abundance of salmon is significantly reduced from historic abundance, and the persistence of this species in the Selway subbasin through the ensuing decades is questionable.

Current habitat capability for salmon in historic key spawning and rearing areas is similar to historic capability, except in Clear Creek, which has been affected by press disturbances across the watershed. These disturbances have resulted in reduced habitat quality and reduced carrying capacity, particularly in the lower reaches of the stream.

Current abundance of spring chinook salmon in the Selway and Middle Fork Clearwater subbasins is very low. Although returns of adults have fluctuated over the past decades, an overall declining trend has occurred. Although salmon continue to return to the Selway subbasin, the species is at high risk of extinction.

Returning salmon in the Selway and Middle Fork Clearwater subbasins were either released as smolts or pre-smolts or are naturally produced progeny from salmon of hatchery origin. The original stock of salmon in the subbasins is extinct, but the Selway subbasin has sustained a naturalized spring chinook salmon population for decades since they were reintroduced in the 1930s and 1940s. Spring chinook salmon are still supplemented annually, usually with fish from the Rapid River hatchery in the Salmon River basin.

A hatchery for spring chinook salmon exists near the mouth of Clear Creek. This hatchery propagates salmon annually and releases them directly into Clear Creek. A weir located near the mouth of the stream traps all adults. In years where number of adults returning is high and the hatchery egg quota is reached, some adult salmon are allowed to migrate upstream to spawn naturally in Clear Creek.

Connectivity: Current connectivity of habitat and subpopulations remains similar to its historic condition, with some exceptions. Most notably, access above Selway Falls has been improved from construction of the Selway Falls fishway, a tunnel that was blasted out of bedrock in the early 1960s. This structure is currently in place and is used by adult spring chinook salmon, although structural integrity has been compromised in recent years. Most tributaries to the Selway River remain accessible to salmon.

The fish weir associated with the hatchery at Clear Creek prevents upstream migration of adult salmon. All adults are trapped at this facility. Historically, Clear Creek was accessible to salmon.

Key Factors and Threats to Spring Chinook Salmon

Key factors and threats affecting spring chinook salmon identified in the *ICBEMP Component Report* are applicable to spring chinook salmon in the Selway and Middle Fork Clearwater subbasins, but many of these involve downstream effects. The *ICBEMP Component Report* lists five factors believed to contribute to the decline of spring chinook salmon in the upper Columbia River basin: (1) habitat degradation; (2) hydropower development; (3) hatcheries; (4) harvest; and (5) predation and competition by non-native species. Although these factors affect spring chinook salmon returning to the subbasins, they largely occur downstream. Other threats and key factors more relevant to the Selway and Middle Fork Clearwater subbasins are included below.

Habitat Degradation: Principal factors related to habitat degradation in the Selway and Middle Fork Clearwater subbasins are associated with excess fine sediment deposition. Degradation has occurred in the Clear Creek area, which has been identified as historic key spawning and rearing habitat. Other degraded streams may affect salmon cumulatively through increased sediment delivery into the mainstem Selway and Middle Fork Clearwater Rivers.

Hatcheries: As previously discussed, spring chinook salmon are heavily supplemented with hatchery salmon from outside the subbasins. It is not known if naturally-produced salmon, which have existed in the Selway subbasin for decades, have developed local adaptations which are affected by continued stocking of hatchery salmon. It is known, however, that despite heavy supplementation in the past ten years, returns of adult salmon continue to decline. Hatcheries have been identified as a major threat to the persistence of wild populations (Quigley et al., 1997). It is possible that since all salmon within the Selway and Middle Fork Clearwater subbasins are hatchery salmon, continued use of hatchery salmon should pose no threat to their continued existence. It is also possible that without continued supplementation, spring chinook salmon would be extinct in the Selway subbasin.

Harvest: Harvest of adult spring chinook salmon is not legal under existing Idaho state fishing regulations. Illegal harvest of spring chinook salmon probably occurs in remote areas where salmon are readily visible in late August and September, which coincides with the wilderness big game hunting season and associated high numbers of people traveling on mainline trails adjacent to streams.

Summary of Spring Chinook Salmon Habitat and Population Status

Map 25 displays habitat and population status for spring chinook salmon. The following ERUs, sub-ERUs, or individual sixth-code watersheds are classified as habitat strongholds: lower Pettibone and Bear, lower Meadow Creek, lower Moose Creek, lower Running and Goat, lower White Cap, and streams in the Selway Headwaters ERU. Clear Creek is classified as a historic stronghold. Due to extremely low numbers of returning adult salmon, no watersheds are classified as strongholds.

PACIFIC LAMPREY (*Lampetra tridentata*)

The Pacific Lamprey is listed as a state endangered species by the Idaho Department of Fish and Game.

The following information is summarized from the *ICRB Aquatic Component Report*. The Pacific lamprey is an anadromous and parasitic lamprey widely distributed along the Pacific coast of North America and Asia. Traditionally, Pacific lampreys were an important ceremonial and subsistence resource for native peoples. They occur in all areas that remain accessible to salmon and steelhead (Simpson and Wallace, 1978).

Historic runs of Pacific lamprey were large; some years 400,000 lampreys were counted as they migrated past Bonneville Dam on the Columbia River (Harrison, 1995). Counts of lampreys passing Ice Harbor Dam on the Snake River totaled 40 in 1993 and 399 in 1994; in comparison, nearly 50,000 were counted annually in the 1960s (Harrison, 1995).

Similar to other anadromous fishes, the distribution and abundance of the Pacific lamprey has been reduced by the construction of dams and water diversions, as well as degradation of spawning and rearing habitat. The species is excluded from large areas where it was historically present, including upstream from Hells Canyon Dam on the Snake River and upstream from Chief Joseph Dam on the Columbia River. Landlocked populations have been found in areas from which the anadromous form has been precluded (Wallace and Ball, 1978), but they have not persisted, and Beamish and Northcote (1988) concluded that metamorphosed lampreys were unable, in such areas, to survive to maturity.

Juvenile lampreys have been observed in the Selway River during Idaho Department of Fish and Game surveys. The location of these observations is upstream of Bear Creek in the Selway River. No known observations have been made in the Middle Fork Clearwater River, or elsewhere in the Selway River. Total distribution and abundance of this species in the Selway subbasin is completely unknown. Considering the facts discussed above, it is very likely that this species' distribution and abundance are significantly reduced from historic conditions.

Key Factors and Threats to Pacific Lamprey

The Idaho Chapter of the American Fisheries Society concluded that dams on the Snake and Columbia Rivers, alteration of streams, and harvest of ammocoetes by bait anglers are the most serious threats to the Pacific lamprey in Idaho. Pacific lampreys, similar to salmonid fishes, are likely vulnerable to land disturbances that cause sedimentation in nursery streams. The ammocoetes depend on quality habitat in freshwater for up to six or seven years before they immigrate to the ocean. Such an extended period in freshwater makes them especially vulnerable to degraded stream conditions. Their anadromous life history necessitates maintenance of spawning and rearing areas. Water quality consistent with robust diatom production may be a key factor for their continued existence.

Although information specific to the Selway and Middle Fork Clearwater subbasins is lacking, key factors and threats affecting the Pacific lamprey are probably largely due to downstream effects.

MOUNTAIN WHITEFISH (*Prosopium williamsoni*)

Historic and Current Status in the Selway and Middle Fork Clearwater Subbasins

USFS and Idaho Department of Fish and Game stream and river survey data indicate that mountain whitefish are by far the most abundant salmonid in the Selway and Middle Fork Clearwater Rivers. Additionally, this species is the most abundant fish in the lower reaches of the larger mainstem tributaries, including Meadow, Moose, Bear, and White Cap Creeks. It is assumed that historic distribution and abundance were similar or the same as existing distribution and abundance. Mountain whitefish in the Clearwater basin are not imperiled. Because of apparent wide distribution and high numbers of adults and juveniles, data collection efforts are not focused on this species, and data are lacking.

NORTHERN PIKEMINNOW (*Ptychocheilus oregonensis*)

Historic and Current Status in the Selway and Middle Fork Clearwater Subbasins

Northern pikeminnow are known to inhabit the Middle Fork Clearwater River and the Selway River below Selway Falls, and are abundant where they occur. Pikeminnow may also occur in the Selway River above Selway Falls. This species is not known to inhabit any tributaries of the Middle Fork Clearwater or Selway Rivers. The species is not imperiled in the subbasins or elsewhere. Current distribution and abundance is assumed to be the same or similar to historic distribution and abundance. There are no known threats to the future persistence of pikeminnow in the subbasins.

OTHER NATIVE AQUATIC SPECIES

The Selway and Middle Fork Clearwater subbasins support a variety of aquatic organisms for which there is a lack of information concerning status, distribution, abundance, and species identification. Aquatic organisms known to inhabit the subbasins include suckers (*Catostomus* spp), dace (*Rhinichthys* spp), other unidentified cyprinids, sculpins (*Cottus* spp), a wide variety of macroinvertebrates (including insects and crustaceans), at least one unidentified centrarchid (which may not be native), mussels, filamentous algae, diatoms, mosses, and various vascular aquatic plants. Some non-vertebrate aquatic organisms found in mountain lakes may be endemic, having never been described or found elsewhere. Lack of information concerning these organisms is considered a significant data gap. Further investigation is recommended.

Amphibians (frogs, toads, salamanders, and their larvae) are present throughout the analysis area. Amphibian species are discussed under the Terrestrial Species subheading.

NON-NATIVE (INTRODUCED) AQUATIC SPECIES

Aquatic species not native to the Selway and Middle Fork Clearwater subbasins have been widely introduced into the subbasins over the past 100 years and represent a significant departure from historic conditions. Introduced species include brook trout, Yellowstone cutthroat trout, hatchery rainbow trout, German brown and Lochlaven brown trout, golden trout, arctic grayling, and coho salmon. Non-native species have been introduced into both stream and lake environments.

Current Status of Introduced Species

Brook trout (*Salvelinus fontinalis*): In the 1930s and 1940s, brook trout were stocked widely across the Selway and Middle Fork Clearwater subbasins, in both streams and lakes. Brook trout were stocked into all fish-bearing streams in the portion of the watershed below Selway Falls, including the mainstem Selway and Middle Fork Clearwater Rivers. Brook trout from this series of stockings are currently present in O'Hara Creek and Clear Creek. Recent survey efforts of other streams below Selway Falls suggest that brook trout are not present except for in the upper reaches of Gedney Creek.

Brook trout are also strongly established in lakes in the Selway subbasin. Although no longer stocked, self-sustaining populations are found within lakes located at the headwaters of Gedney, Three Links, North Fork Moose, East Fork Moose, Running, Pettibone, Mink, and Meadow Creeks. Stream-dwelling populations are found in Gedney, Three Links, Rhoda (Moose Creek ERU), Lizard (Moose Creek ERU), East Fork Moose, Pettibone, and Running Creeks, downstream of lakes where they were stocked. Brook trout were not stocked in these streams, but stream-dwelling populations became established as fish from the lakes emigrated downstream. All populations are considered strong and are at low risk of extinction. Adverse ecological effects associated with brook trout include elimination of native westslope cutthroat trout, elimination of and/or hybridization with bull trout, and disruption of fragile lake ecosystems where brook trout occur.

Yellowstone Cutthroat Trout (*Oncorhynchus clarki bouvieri*): Yellowstone cutthroat trout were stocked into every road-accessible fish-bearing tributary to the Selway River, including Deep and Running Creeks, and the Middle Fork Clearwater River from the early 1930s through the 1950s. Yellowstone cutthroat trout have not been stocked in streams since the late 1950s.

In addition to stream stocking, Yellowstone cutthroat trout and rainbow/cutthroat hybrids were stocked in many mountain lakes in the Selway subbasin. This subspecies was stocked in lakes as recently as 1982. Stocking occurred in lakes in the following watersheds: Three Links, North Fork Moose, East Fork Moose, Bear, White Cap, Marten, Pettibone, Bitch (Upper Selway Canyon ERU), Little Clearwater, and in the Selway headwaters.

Hatchery Rainbow Trout: Similar to Yellowstone cutthroat trout, hatchery rainbow trout were stocked widely in streams throughout Selway and Middle Fork Clearwater subbasins, including the mainstem Selway and Middle Fork Clearwater Rivers. Hatchery catchable rainbow trout were stocked in the mainstem Selway River below Selway Falls as recently as 1991.

Hatchery rainbow trout have also been introduced into mountain lakes in the Selway subbasin. Rainbow trout were stocked in lakes at the headwaters of the following streams: North Fork Moose Creek, East Fork Moose Creek, Bear Creek, White Cap Creek, Three Links Creek, and streams in the Selway Headwaters ERU. In a few lakes, rainbow trout were stocked as recently as 1995 and are the only species found in these lakes.

Arctic Grayling (*Thymallus arcticus*): Arctic grayling were historically stocked into a small number of lakes in the Selway subbasin over the past decades, and in Three Links Creek in 1941. The species is currently not present in any of the locations where it was stocked or anywhere in the Selway subbasin. No known encroachment and establishment of grayling into streams has occurred.

Golden Trout (*Oncorhynchus aquabonita*): Golden trout were introduced into a number of mountain lakes over the past decades, including lakes in the Moose, Bear, and Marten watersheds. Stocking in these areas occurred as recently as 1977. Mountain lake surveys conducted in the 1980s and 1990s did not document the presence of golden trout in these lakes or in any other lakes in the Selway subbasin. It is possible that golden trout are still present in lakes in the White Cap ERU, however, which have not been recently surveyed.

German Brown and Lochlaven Brown Trout (*Salmo trutta*): Brown trout were widely introduced into the mainstem Selway River in the 1940s. Past and current surveys and creel censuses have not documented the presence of brown trout anywhere in the Selway and Middle Fork Clearwater subbasins. Brown trout were also stocked in Clear Creek in the early 1940s. No brown trout have been found in past and current survey efforts.

Coho Salmon (*Oncorhynchus kisutch*): Coho salmon were introduced to Meadow Creek, O'Hara Creek, and the mainstem Selway River in the mid- to late 1990s in an effort to establish a run of adult coho salmon in Meadow Creek and tributaries to the Selway River below Selway Falls. Although coho salmon pre-smolts have been observed during post-stocking surveys, the number of adult returns is unknown due to monitoring difficulties. Stocked coho salmon were obtained from a lower Columbia River hatchery.

Smallmouth Bass (*Micropterus williamsoni*): Smallmouth bass were introduced into the Clearwater River in the 1950s, 1960s, and 1970s. Smallmouth bass are common in the Clearwater River between the confluence of the South Fork and Middle Fork Clearwater Rivers and the mouth of the North Fork Clearwater River. Bass occur in the lower reaches of the Middle Fork Clearwater River. The species has not been documented in the Selway River, but may be present in low numbers in the very lowest reaches of the river. In general, the population of smallmouth bass in the Middle Fork Clearwater River is not strong, and is considered transitory at best, occurring in these areas opportunistically during the hottest summer months.

Adverse impacts to native fish are associated primarily with predation of juvenile native fish by adult bass. Competitive displacement of native fish appears not to have occurred.

LANDSCAPE ECOLOGY

COMPOSITION, STRUCTURE AND PROCESS

Plant communities in the Selway and Middle Fork Clearwater subbasins can be seen as a mosaic of patches that change in composition, size, and juxtaposition over time. Wildlife and human uses respond to the existing pattern of vegetation. Processes like plant community succession, fire,

insect and disease activity, drought and grazing, all change the pattern that exists at any one time. Features like climate, soil, slope, aspect and elevation, control the bounds within which patterns can change.

Vegetation response units (VRUs) and habitat type groups (HTGs) within VRUs were used to describe the bounds within which patterns of vegetation change. Within these delineations, presettlement processes like climate, fire, and insect and disease activity were likely to operate within predictable ranges. See appendix B, Vegetation Response Units and Appendix A, Habitat Type Groups. VRUs are shown in Map 30, and HTGs are shown in Map 31.

Understanding how the disturbance regimes worked, and the pattern of vegetation change, is fundamental to ecosystem management in the subbasins. This understanding can be used to design management systems that sustain patterns of vegetation and the scale, frequency, and kind of change to which native species are adapted.

Historic Vegetation Conditions

John Leiberg surveyed the Selway and Middle Fork Clearwater subbasins as part of the Bitterroot Forest Reserve in 1897 and 1898 (Leiberg, 1898). Recent burns (to perhaps 40 years old) covered about 35 percent of the area surveyed. Small trees (poles) or open stands of medium trees probably amounted to about another 40 percent. Dense stands of medium trees or large trees in open or dense stands occupied less than 25 percent of the subbasins. Thirty-four percent of the area surveyed was dominated by Douglas-fir. Ponderosa pine (21 percent) occurred as pure and mixed stands in the canyons below 6,000 feet. Lodgepole pine (17 percent) dominated mid elevation forests in the Selway headwaters and headwaters of Meadow Creek. Grand fir dominated old growth was abundant near Clear Creek and old growth cedar in valley bottoms from O'Hara Creek to Moose Creek and Bear Creek. Western larch and western white pine were quite uncommon. Whitebark pine and alpine larch were widely distributed above 6,000 feet but seldom dominant (less than one percent). Subalpine fir and Engelmann spruce occupied about 18 percent of the subbasins between 6,000 and about 8,000 feet. Acres and percent in each class are shown in Table 4.22.

Table 4.22: Historic Vegetation Classes from 1914

Size Class in 1911	Acres	Percent of Surveyed Part of the Subbasins
Not mapped	69,984	5
Alpine	92,942	7
Barren	167,826	12
Grassland	38,753	3
Recent burn (includes seedling and sapling)	180,348	13
Low volume timber (open pole or medium trees)	208,350	15
High volume timber (closed pole, medium tree or large tree)	669,331	47

Departures of Current Vegetation Composition and Structure from Historic Conditions

The following analysis and discussion of historic and current vegetation is based on aerial photo interpreted data from 1932 to 1939 and photo interpreted and satellite imagery for three subsampled areas equivalent to about 10 percent of the Selway and Middle Fork Clearwater subbasins. Ecologists also used satellite imagery and photo interpretation for the entire assessment area for current status information. Limitations in these data occur because some

data are 20 years old or because of inherent limitations in satellite image classification or photo interpretation. Cover type, size-class and canopy information for subsampled areas in the 1930s are shown in Maps 38 to 40. Current vegetation cover types, size class, and tree canopy cover for the entire assessment area are shown in Maps 41 to 43.

Departures In Composition: The greatest departures from historic conditions are:

- Severe declines in whitebark pine due to fire exclusion, blister rust, and mountain pine beetle. Alpine larch has also been affected by fire exclusion.
- Significant declines in ponderosa pine (especially large pine in open stands) due to fire suppression and forest succession.
- Increases in more shade tolerant tree species, like grand fir and western red cedar, due to fire suppression and forest succession. Subalpine fir does not appear to have increased.
- An increase in lodgepole pine, probably due to conifer establishment on old burns.
- Moderate declines in shrubland due to forest succession.
- Loss of recent burn patches. Some insect-affected areas now provide patches of fresh snags.
- Establishment of annual grasslands and noxious weeds on grassland habitat types on low elevation steep south facing slopes.
- A decline of western white pine, never abundant, due to blister rust.
- An increase of montane park due to succession on burned areas and areas of thin soil.

Table 4.23 shows changes in cover types from the 1930s to the 1990s in subsampled areas.

Table 4.23: Changes in Vegetation Cover Types in Subsampled Areas

Cover Type	1930s Acres (Percent of Area)	1990s Acres (Percent of Area)	Percent Change
Grassland	1,447 (1)	1,799 (1)	+24
Herbaceous clear cut	0 (0)	647 (<1)	+
Montane park	3,138 (2)	11,291 (8)	+260
Shrubland	20,965 (15)	15,421 (10)	-26
Ponderosa pine-Douglas-fir	17,100 (12)	13,585 (9)	-21
Lodgepole pine	9,303 (7)	15,129 (10)	+63
Subalpine fir	32,140 (23)	32,435 (22)	+1
Mesic mixed conifer	33,436 (24)	42,809 (29)	+12
Whitebark pine	4,077 (3)	316 (<1)	-92
Rock or barren land	15,220 (11)	14,659 (10)	-4

Table 4.24 shows the current extent of cover types and size classes for the entire assessment area, from aerial photo interpretation and satellite imagery.

Table 4.24: Cover Types and Size Classes in the Selway and Middle Fork Clearwater Subbasins

Cover Type	Total Acres	Percent of Subbasins
Agriculture: hay, crop, or pasture	259	<1
Foothills Grassland	23,896	2
Disturbed Grassland	153*	<1
Montane park	56,762	4
Alpine scrub	303	<1
Mesic shrub	73,585	5
Cold shrub	55,196	4
Xeric shrub	6	<1
Hardwoods	2,173	<1
Herbaceous clearcut	3,165	<1
Riparian forest	3	<1
Riparian meadow-shrub	479	<1
Xeric forest: ponderosa pine and Douglas-fir	70,650	5
Douglas-fir, xeric or mesic	144,582	11
Mesic mixed conifer	355,725	26
Spruce-fir forest	330,109	24
Lodgepole pine	207,297	15
Whitebark pine	5,197	<1
Rock-barren	43,082	3
Water	2,194	<1
Snow	970	<1

* Note: The area of disturbed grassland is known to be much higher than shown here.

Forest structure within communities includes lifeform, size, canopy density, or canopy layers. Table 4.25 and Map 39 show forest size classes in the 1930s for subsampled areas and Map 42 shows forest size classes for the entire assessment area in the 1990s.

Departures In Size-Class: The greatest departures in size-class are:

- The decrease in nonforest cover is due to forest establishment on old burns. Harvest has increased nonforest in other areas, but to a relatively small degree. The consistently large area of nonforest is due to the abundance of high elevation rocky ridges and dry slopes that cannot support tree growth.

- The increases in seedling/sapling and pole classes are due to tree growth on old burns, while relatively few recent burns have occurred.
- The decreases in medium and large tree classes are more difficult to interpret because the area affected by fire suppression, resulting in tree growth, is much larger than the area affected by recent harvest, resulting in loss of large trees. The Middle Fork Clearwater area has lost large trees due to harvest, and the White Cap Creek area has lost large trees either due to fire or a mapping inconsistency. It is probable that net loss of the large tree component is confined to moist areas in the lower Selway and Middle Fork Clearwater subbasins where harvest of mixed conifer old growth has been extensive.

Table 4.25: Changes in Tree Size Classes in Subsampled Areas

Size Class	1930s Acres (percent)	1990s Acres (percent)	Percent Change
Nonforest	51,523 (35)	44,935 (31)	-13
Seedling/Sapling	5761 (4)	12,991 (9)	+125
Pole	6402 (4)	24,626 (17)	+284
Medium tree	59,164 (41)	45,651 (31)	-23
Large Tree	22,606 (16)	17,131 (12)	-24

Table 4.26: Existing Tree Size Classes

Size Class	Percent of Area in Entire Subbasin
Nonforest or nonstocked	27
Seedling/sapling	13
Pole	9
Medium tree	23
Large tree	28

Departures In Canopy Density: Canopy density is an important structural attribute because it affects plant vigor, susceptibility to insects and disease, potential for crown fire, wildlife cover, and successional pathways. Table 4.27 and Maps 40 and 43 display tree canopy cover for the 1930s in the subsampled areas and the 1990s for the entire assessment area. Departures in canopy density have occurred in all classes as follows:

- More acres are forested, probably due to fire exclusion.
- The increase in acres with low canopy is probably due to establishment of seedling and sapling stands on burns, and to a lesser extent, on old harvest units.

- Areas with moderate canopy have declined while areas of high canopy have increased, probably due to fire exclusion. This has likely been accompanied by increased vertical layers within the canopy, as young, more shade tolerant trees grow up beneath the overstory.
- Increased canopy density and layering indicate a greater probability of crown fire, potentially more severe fire effects, and consequent effects to sediment regimes and successional pathways.

Table 4.27: Changes in Tree Canopy Cover in Subsampled Areas

Size Class	1930s Acres (percent of forested)	1990s Acres (percent of forested)	Percent Change
Low (10-39%)	21,884 (23)	25,811 (26)	+18
Moderate (40-69%)	52,670 (56)	45,908 (46)	-13
High (70% +)	19,379 (21)	28,599 (29)	+48
Total forested acres	93,393	100,318	+7

Table 4.28 shows tree canopy cover for the entire assessment area. Current tree canopy cover across the subbasins is similar to that in the subsampled areas, indicating that changes in canopy density have likely occurred throughout the subbasins.

4.28: Existing Tree Canopy Cover

Tree Canopy Cover	Percent of Forested Area in Entire Subbasin
Low	24
Moderate	46
High	30

Landscape Structure

Across landscapes, the variation in patch size and extent has implications for the wildlife species that use the landscape, watershed processes like erosion, and the plant species that are adapted to certain scales of migration and colonization. Patches are defined as contiguous areas of similar general vegetation structure. Patches are defined by their seral conditions:

- Open early seral includes shrubs and herbaceous communities, and open seedling or pole stands.
- Closed early seral includes seedling or pole stands with moderate or high canopy.
- Open mid-seral includes medium trees with low canopy.
- Closed mid-seral includes medium trees with moderate or high canopy.
- Open late seral includes large trees with low canopy.

- Closed late seral includes large trees with moderate or high canopy.

Table 4.29, below, shows how seral patch properties have changed in the subsampled areas of the subbasins. These data must be interpreted with caution because of the differences in methods and resolution in delineation.

Allowing for inconsistencies in mapping resolution between the 1930s and 1990s, it appears the following departures in landscape structure have occurred:

- The decrease in the average and maximum patch size of open early seral communities is probably due to fire suppression and succession toward closed forests. Harvest has increased nonforests in limited areas, but to a relatively small degree, while average size of harvest openings is uniformly smaller than many fire-created openings. That the total extent of open early seral communities has appeared to increase may be due to the development of montane park or alpine scrub on formerly barren ridges.
- The increases in the closed seedling-sapling and pole classes are due to increasing stand density on old burns.
- Mid-seral open forest has increased in extent, but declined in patch size. Some of the increase may be due to mortality in mixed subalpine fir-whitebark pine stands, increased root rot mortality in mixed mesic conifer stands, or the increase may be a product of mapping inconsistency.
- Mid-seral closed forest has decreased in extent, patch size, and variability. Some of these changes may be due to transition to late seral closed forest, or mortality that has shifted the stands to more open conditions.
- Late seral open forest has decreased in extent, patch size, and variability of patch size. This decrease is probably due to increasing stand density and coalescence of adjacent stands into closed canopy conditions, due to fire exclusion.
- Decreases in late seral closed canopy forest may be due to fragmentation effects of harvest in the Middle Fork Clearwater and lower Selway areas.

Table 4.29: Historic and Current Patch Characteristics for Subsampled Areas

Seral Stage	Decade	Total Acres	Average Patch size (acres)	Max patch Size (acres)	Standard Deviation (acres)
Early Seral Open	1930s	33,369	402	17,308	1,918
	1990s	38,677	55	4,520	259
Early Seral closed	1930s	4,546	162	2,685	502
	1990s	28,020	55	8,706	417
Mid-seral Open	1930s	10,641	150	1,291	243
	1990s	15,828	29	1,135	74
Mid-seral Closed	1930s	48,615	1,157	26,666	4,266
	1990s	29,823	53	4,237	220
Late Seral Open	1930s	4,435	193	456	175
	1990s	466	15	87	18
Late Seral Closed	1930s	20,248	1,558	9,295	3,194
	1990s	16,665	73	2,742	280

Old Growth Forests

Old growth may be described simply as forests having old trees and related structural attributes, like snags and down wood (Moir, 1992). Old growth characteristics vary by region, forest type, and local conditions. In the Selway and Middle Fork Clearwater subbasins, old growth and its historic settings can include: (1) open stands of ponderosa pine maintained by frequent low severity fire; (2) single or multilayered old cedar in valley bottoms; (3) multilayered stands of grand fir and Engelmann spruce with periodic small fires, much rot and down wood; (4) mixed stands of young and old Douglas-fir, western larch, and grand fir with periodic mixed severity fire that usually left some large old trees intact; (5) multilayered stands of Engelmann spruce and subalpine fir along stream bottoms or other areas protected from fire, and: (6) occasional stands of whitebark pine, lodgepole pine, or Douglas-fir missed by past fire, but seldom persisting long in a specific landscape position.

Leiberg described only a few types and areas of extensive old growth in 1898: open ponderosa pine in the canyons and old growth cedar in the valley bottoms. To develop a basis for estimating the possible amount and location of current old growth, ecologists delineated areas of mature forest in the 1930s and subtracted the areas that had been affected by harvest or high severity fire. Map 44 shows where large trees dominated stands in the 1930s and 1940s and where the same stands remain today. Also see Appendix H: Old Growth.

Many of the stands of fairly large trees in the 1930s, that still exist, would probably be considered old growth today, using the north Idaho criteria (Green et al., 1992). Some of the extensive lodgepole, ponderosa pine and Douglas-fir stands in the Selway Headwaters ERU are also known to be old, although they were not delineated because of their small size, so actual old growth is probably more extensive than displayed here. In the 1930s, at least 16 percent of the potentially forested acres on the national forest lands of the subbasins were stands of mature (probably 80 years or more), but not necessarily old growth at that time. Total area in mature forest is greater today (between 20 and 25 percent) than historically, due to fire exclusion.

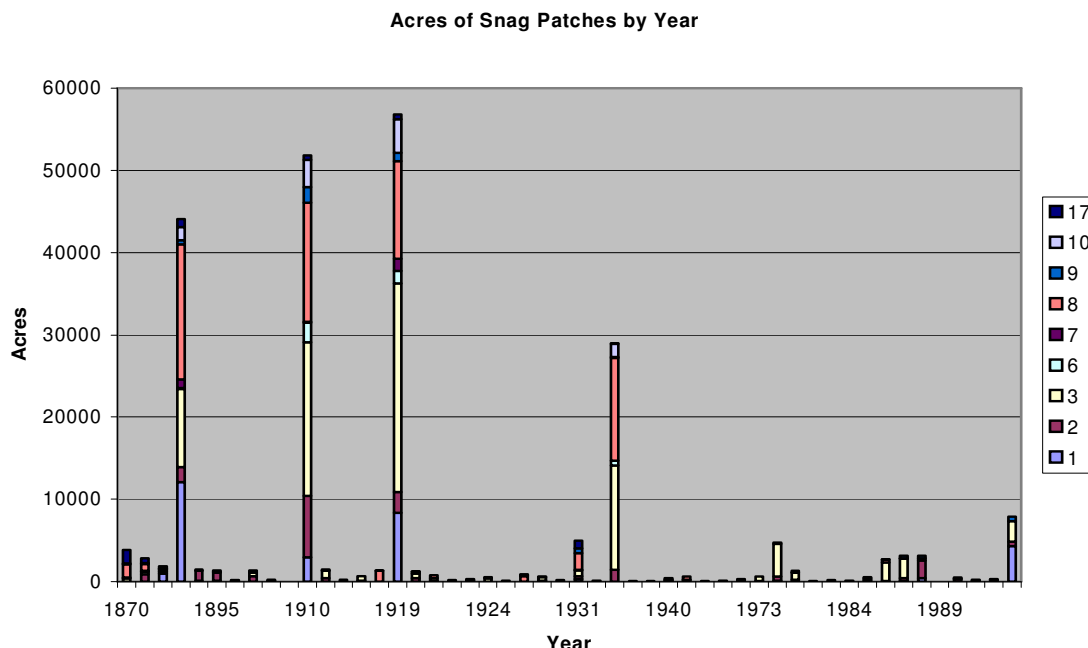
Stands with large trees historically tended to be concentrated at the west end of the assessment area (VRUs 7, 10 and 17) or in areas maintained by frequent low severity fire (VRU 3). In VRUs 7, 10 and 17, these large blocks of mature forest have been highly fragmented by recent harvest. See Map 44. In VRU 3, which is mostly in wilderness, ingrowth due to fire exclusion has probably exceeded losses due to fire. However, the kind of old growth is changing, due to fire exclusion. More multilayered, mixed species old growth occurs, while open ponderosa pine old growth has decreased. In other parts of the subbasins, stands with large trees historically tended to be more fragmented and isolated from one another, often associated with north slopes and draws where fire might miss them. This old growth has probably increased in extent and connectivity with fire exclusion.

Snags

Snags and down wood are among the most critical products of natural fire and pathogen regimes in the subbasins. These materials provide foraging and nesting sites for birds and small mammals, enrich chemical and physical properties of soil, and provide diverse microsites for establishment of plants and sites for nitrogen fixation.

Episodic pulses of snag production were an important source of snag patches in natural ecosystems (see Figure 4.28). Stand replacing and mixed severity fire in mature forests would generate snag densities of 40 to more than 200 snags per acre, nine to more than 21 inches in diameter.

Figure 4.28: Acres of Snag Patches by Year



The frequency and size of such pulses were estimated by VRU (vegetation response unit) for the period 1870 to 1996 for the subbasins. These are conservative estimates based on fire area, fire regime (typical percent mortality), and percent of burn likely affecting stands of medium or large trees. From 1889 to 1934, prior to effective fire suppression, about every 15 years very large areas of fresh snags were produced (20,000 to more than 50,000 acres in patches of a few to several thousand acres). This frequency of large fire is well correlated with other time periods and areas in the northern Rocky Mountains. From 1870 to 1934, not counting the large fire years, an average of about 857 acres of smaller patches of dense snags (tens of acres to a few thousand acres) were produced annually, most often in VRUs 3 and 8, and about every other year in the subbasins.

In areas where fire is excluded or timber harvest removes live or dead trees, these pulses do not occur. Since 1935, large pulses of fire-killed snags have been absent and the period between small pulses has increased. This underscores the need for restoration of more natural fire regimes throughout the subbasins, but particularly in VRUs 3 and 8 which seem to have historically provided for the most abundant snag production because of the extent of these VRUs, likelihood of fire, and productivity sufficient to grow medium and large trees between fires. The fires that occurred in 2000 were not included in the following figure or discussion, and have added additional snags in the Selway Headwaters ERU and some in the Upper Selway Canyon ERU.

LANDSCAPE DISTURBANCE

A disturbance is an event that causes a significant change from the normal pattern in an ecosystem (Pickett and White, 1985). A disturbance regime refers to the frequency, severity, scale and other attributes of a recurring disturbance (Hobbs and Huenneke, 1992). Plant and animal species have typically evolved adaptations to survive in the disturbance regimes typical of their environment. When human management drastically alters the frequency, severity or scale of disturbance, some plant, fish and wildlife species will not be able to adapt, or certain habitats or landscape elements may be lost, and this may impact dependent species.

This section describes changed disturbance regimes for terrestrial systems in the subbasins. Restoration of the pattern of disturbance appropriate to a given setting was a key consideration in developing management themes and recommendations.

Insects and Disease

An index of forest health is its capacity for renewing itself (Leopold, 1949). This assessment has used the comparison of historic and current pattern and process as the most appropriate measure of ecosystem health. A landscape that retains critical elements (communities, processes, and patterns) is considered to have the most likelihood of being able to renew itself after stress and to retain its productive potential (Hahn and Hagle, 1993). The following discussion addresses just one aspect of forest health: the changes that have occurred in forest vegetation, and how this is likely to affect susceptibility to some insect and disease organisms.

Budworm: Engelmann spruce budworm is a common defoliating insect in the subbasins (Carlson, 1993). Outbreaks seem to be sporadic and cause some mortality or susceptibility to bark beetle attack in susceptible tree species. Host species are later seral species like grand fir, subalpine fir, Engelmann spruce, and Douglas-fir, which have increased with fire suppression. Trees stressed by overcrowding or other sources of drought, and multistory stands of susceptible trees, increase the severity of attacks. Natural controlling agents are predators and parasites including wasps, flies, birds, ants, spiders, and beetles. Changes in vegetation in the subbasins suggest that susceptibility to budworm outbreaks has probably increased over historic levels, because of changes in tree species composition and stand density, mostly at mid and low elevations. However, actual changes in activity levels have not been observed, perhaps due to the sporadic nature of budworm outbreaks, and their dependence on other climatic factors.

Beetles: Mountain pine beetles attack ponderosa pine, lodgepole pine, western white pine and whitebark pine. They select larger (usually older) trees and trees stressed by drought or other agents. The cycle in which older lodgepole pine (Amman, 1991) are killed by beetle activity, are replaced by fire, and regenerate to lodgepole pine, is widely recognized. Ponderosa pine is a host for western pine beetle, and Douglas-fir is a host for Douglas-fir beetle. With fire suppression, more Douglas-fir has grown into larger size classes, susceptible to beetles. Regional aerial surveys of insect caused tree mortality indicate high levels of Douglas-fir beetle activity in the Upper Selway Canyon ERU, where departures from historic fire frequency are marked, and stand density has increased. Nematodes, fungi, flies, beetles, birds, and cold temperatures are important controls on beetle populations. Beetle activity levels were historically strongly linked to patterns of fire and drought. Fire weakened or drought stressed trees are most susceptible. Large patches of post-fire stressed trees used to occur periodically. Today, larger, continuous areas of older, more susceptible trees are now present in the subbasins in the lodgepole, whitebark, and Douglas-fir communities. The possibility exists for larger epidemic outbreaks of some bark beetles.

Blister Rust: Blister rust is an exotic pathogen introduced to the United States in 1909 (Monnig and Byler, 1992). Western white pine and whitebark pine are highly susceptible. Western white pine has been virtually eliminated from its historic range. Whitebark pine has suffered high mortality in many areas. There has been considerable progress in development of rust resistant white pine varieties, but little work has been done with whitebark pine. Whitebark pine is being replaced in the Selway subbasin by subalpine fir, Engelmann spruce, lodgepole pine, or montane herb or shrublands (Quigley et al., 1997).

Root Diseases: Root diseases are fungi that can affect all sizes, ages and species of tree (Hagle, Tunnock, Gibson, and Gilligan, 1987). In the subbasins, grand fir and Douglas-fir are most highly susceptible and the prevailing root pathogens affecting them are armillaria and annous root rots. Areas susceptible to root disease appear to have increased as forests in the subbasins have shifted to more grand fir and Douglas-fir. In grand fir habitat types, the effect has been to create stands of young, uneven aged grand fir and Douglas-fir, with shrubs and

hardwoods. Where ponderosa pine or larch are present, these trees may grow more rapidly because of the thinning effect of root diseases. In red cedar habitat types, the progression of root disease is rapid and favors dominance by more resistant cedar. Levels of inoculums have probably increased in some areas. At very high levels, more tree species become susceptible. Fire tends to decrease root rot by favoring species like pine or western larch that are more resistant to fire and root rots.

Mistletoe: Five species of dwarf mistletoe affect conifers in the subbasins. Douglas-fir and lodgepole pine are most commonly infected. The characteristic witch's brooms indicative of mistletoe provide hiding cover and resting areas for birds and small mammals. Mistletoe decreases tree vigor. It increases with development of dense or two-story stands in which the plant parasite is spread more readily. These changes are likely to have occurred in many low and mid elevation Douglas-fir stands. Lodgepole stands are more likely to have Engelmann spruce and fir in the understory, so spread is unlikely. Stand replacing fire will eliminate mistletoe from the affected area for a short while.

Fire Disturbance

This section addresses fire history in the Selway and Middle Fork Clearwater subbasins, presettlement fire regimes, current fuel accumulations, and ignition probabilities. Fire has been a keystone process of nutrient cycling and plant community dynamics for millions of years. Changes in fire regimes have consequences for both terrestrial and aquatic ecosystems. Factors considered in assessing current risk of wildfires compared to presettlement conditions are: changes in vegetation structure indicative of changes in fuel quantities and distribution; number of fire intervals missed; and likelihood of ignition.

Fire History: Large fires of more than 1,000 acres occurred somewhere in the subbasins about every three years, based on analysis of fire history data from 1870 to 1934. Fire history from about 1870 to 1934 is shown in Map 32, and from 1935 to 2000 in Map 33. Of the national forest area where fire history is known, about 22,285 acres burned annually from 1870 to 1934 when fire suppression became effective. This amounted to about 2.2 percent of the area burned annually. Most of these acres burned in a few severe fire years: 1889, 1910, 1919, and 1934. A severe fire year once in about 15 years has been common in the Northern Rocky Mountains since at least about the 1500s (Barrett et al., 1997).

From 1935 to 1978, when fire suppression was the policy on all lands in the subbasins, a total of 13,805 acres burned, or less than 314 acres annually. This was more than a 95 percent decline from the presettlement record. During the implementation of a fire use program in the Selway-Bitterroot Wilderness from 1979 to 1996, about 159,143 acres have burned over the subbasins, or about 8,842 acres annually. This is a 60 percent decline from the presettlement record, if we assume similar climatic conditions during the two periods. Prescribed management ignited fires have been used to reduce fuels or improve wildlife forage since the 1960s. An average of 845 acres have been burned annually from 1980 to 1998, often in the spring and in low elevation dry environments. The season and severity of disturbance have not simulated presettlement processes.

Fire Regimes: For millions of years, lightning has ignited fires and changed the pattern and composition of communities and habitats in the landscape. Most native species have evolved in an environment of characteristic frequency, severity, and scale of wildfire. Presettlement fire regimes are described by their characteristic severity (nonlethal, mixed severity, lethal) and frequencies (very frequent: 5 to 25 years, frequent: 25 to 75 years, infrequent: 75 to 150 years, and very infrequent: 150 to 300 years) (Morgan et. al., 1996). Fire regimes are inferred from habitat type group and terrain setting. Presettlement fire regimes are shown in Map 34. See also Appendix E, Fire Regimes.

Since fire has been such a prevalent agent of change and pattern in the landscape, understanding fire regimes is useful in interpreting existing conditions and in designing activities that provide the array of communities and habitats historically represented. Severity of an individual fire depends greatly on local fire weather. Fire regimes describe the typical fire pattern, but not necessarily the behavior of any specific fire. Most vegetation types and terrain in the subbasins are prone to fires at 75 to 150 year intervals. These fires are often of mixed severity, with large patches of lethal fire under severe fire weather conditions. Less severe fires may occur at more frequent intervals in many stands, but change stand composition only slightly.

Table 4.30: Presettlement Fire Regimes in the Subbasins

Fire Regime	Area (acres)	Percent of Subbasins
Very frequent, nonlethal	217,586	16
Frequent, Mixed	188,997	14
Infrequent, Lethal	270,852	20
Very Infrequent, Mixed	645,903	47
Extremely infrequent, Mixed	46,717	3

Fuels: Wildland fuels provide the energy source for fire. Fuels consist of both living and dead vegetation, the latter in various stages of decay. Fuels occur in three fairly distinct strata: ground, surface, and aerial. A fire can burn in one, two, or all three strata at once, or change the layer in which it is burning as fuels and environmental conditions change throughout an area.

Fuels vary across the landscape and over time in their quantity, flammability, vertical distribution and spatial distribution. Quantity increases with increasing biomass or accumulation of dead material on a site. As stands age, they accumulate both living and dead material. Flammability is controlled largely by moisture content and plant phenology. Vertical connection of fuels (ladder fuels), tend to increase with succession as young trees grow up underneath older trees. This increases the potential for crown fire. Spatial distribution changes with time and environments. With increasing fuel loads, and shifts in structural stage from open young forest to closed canopy mature forest, both vertical and horizontal continuity of fuels has increased in many areas of the subbasins.

Patterns of fuels in the 1930s contrast strongly with those that occur today. Areas of grassland and open forest with grassy understories prone to low severity surface fires have declined. Areas of shrubs, seedlings, and saplings less susceptible to severe fire have declined, while areas of mature forest with greater fuel accumulations and connection of ground fuels to the tree crowns have increased. These mature forests are prone to severe crown fires when conditions are both dry and windy.

Departures in Fire Regimes: Over much of the subbasins, fire is now allowed to burn much less often, and over smaller areas, than in presettlement times. The interval between fires has increased most markedly in the very frequent and frequent fire regimes. Where this interval has increased, the potential severity of fires has increased because over longer intervals, more fuels accumulate. To evaluate where this has occurred, ecologists assumed that if the last fire or harvest disturbance has occurred within the range of the presettlement fire-free interval, potential fire severity would be within the presettlement range. Map 35 shows where the disturbance interval and expected fire severity have increased over presettlement times. This information can be used to help prioritize areas for vegetation restoration through harvest, other vegetation treatment, or use of fire.

Typically, areas of frequent and very frequent fire in presettlement times are highly departed from their fire regimes. It is likely that fuels in these areas are increased in quantity and ability to carry fire into the tree crowns and have the potential to burn with greater lethality and effects to plant communities and watershed conditions, than under presettlement disturbance regimes.

Areas of infrequent fire are little departed from their presettlement fire intervals, considered stand by stand, but are departed at the landscape scale, because of the increasing dominance of structural stages more prone to severe fire behavior under certain weather conditions.

Departures in Fuel Accumulations: Areas with fuel accumulations and distributions outside the range of historic variability may pose some risk for large fires, more severe in fire intensity and watershed impacts, than was typical of presettlement times. The Boise National Forest developed an approach adapted and used here to identify these areas (USDA Forest Service, 1996).

Where missed disturbance intervals or high fuel accumulations coincide with high natural fire ignition rates, actions to reduce fuel quantity or connectivity may be appropriate. Map 37 shows areas of potentially high fuel accumulations in dry habitat types, and subwatersheds with relatively high ignition rates (more than one fire start per square mile per decade).

Through querying the timber stand data base or the attribute tables of satellite imagery covers, the following habitat type groups, cover types, and canopy closure classes were identified as likely to have fuel types outside the range of natural variability:

- Habitat type groups 1 and 2 (Douglas-fir and ponderosa pine), on all VRUs, all cover types, and canopy closure classes greater than 40 percent;
- Habitat type group 3 (dry grand fir), on VRU 3 or 4, Douglas-fir and ponderosa pine or mixed conifer cover types, and canopy closure classes greater than 70 percent;
- Habitat type group 9 (dry subalpine fir), VRUs 1, 2, 5, 6, 9; lodgepole pine cover type, pole size or larger, that have not burned within the last 120 years.

Areas with more than 20 percent of the watershed in these fuel types were rated as having a high likelihood of extensive fuel accumulations outside the presettlement range. These are usually in Douglas-fir and ponderosa pine cover types with moderate or high canopy closure. These would likely have high vertical fuel continuity as well, which would support crown fires readily. Areas with 10 to 20 percent of the watershed in these fuel types were rated as moderate (having a moderate likelihood of fuel accumulations outside the presettlement range). Areas with less than 10 percent of the watershed in these fuel types were rated as low risk for alteration of fuel conditions.

Ignition probabilities within watersheds were evaluated for the last twenty years. If more than one ignition per decade per square mile occurred in the watershed, it was assumed ignition risk was high. High ignition probabilities generally occur in the Middle Fork Clearwater and lower Selway subbasins, from Kooskia to Selway Falls.

Map 37 shows where watersheds with potentially unnaturally high fuel accumulations are expected to occur, and where ignition probabilities are high. Some of these watersheds include private inholdings and administrative facilities that may be at risk of fire: North Star Ranch, Running Creek Ranch, Paradise, Moose Creek, and campgrounds on Paradise and Deep Creek Roads.

Areas of highest departure in fuel conditions and missed fire intervals are in Running Goat, Upper Selway Canyon, Whitecap Creek, Indian Creek, Deep Creek and the Little Clearwater portion of the Selway Headwaters ERUs, as well as some of the private lands in lower Clear Creek and Middle Fork Clearwater. Historic ignition probabilities are not known for the private lands, but the juxtaposition of fuels and private development suggest some need for fuel treatments, either fire or thinning. Not shown are smaller areas, such as face drainages in Meadow Creek, which also likely have high fuel accumulations.

Historic ignition probabilities have not been high in the Upper Selway Canyon and adjacent ERUs, but the juxtaposition of potentially high fuels augmented by recent bark beetle mortality suggest that ignitions that do occur at low elevations may result in higher probability of more

severe fire than historically. Higher elevations in Running Goat, Little Clearwater, Indian Creek and Pettibone and Bear Creek ERUs also have significant areas near the outside of their fire interval for lodgepole pine or spruce-fir forests; the potential for large severe fires in these ERUs may be increased over historic conditions. Ignition risk from human causes will likely increase along low elevation travel routes as visitor use increases.

Departures In Area Affected by Fire or Harvest: Table 4.31, below, shows acres of wildfire and harvest by decade the national forest portion of the subbasins. Map 32 shows fires burned by decade prior to fire suppression (about 1934) and Map 33 shows acres burned since fire suppression. Areas burned in the wilderness since 1978 include fires allowed to burn for resource benefits.

The map, table, and stand origin information suggest that fire was a pervasive disturbance within the subbasins before Euro-American settlement. Information in Barrett et al. 1997 also supports the conclusion that extensive fire activity occurred at least every decade or two from the mid 1500s (oldest fire scar data) to the early 1900s, and that changing land use patterns and attempts to exclude fire have succeeded in greatly reducing the scope of fire on the landscape. Fires affected more than 22,000 acres per year before 1935. From 1935 to 1978, fires have only burned about 313 acres annually, and since the institution of the prescribed natural fire program, about 8,800 acres have burned annually, mostly confined to wilderness.

Acres of timber harvest replaced acres of fire disturbance from 1960 through the 1990s in the lower Selway, but the kind and pattern of harvest did not replicate the ecological effects of fire. Harvest removes trees and sometimes heavily disturbs soil. Few snags and low levels of large down wood remain after harvest and slash treatment. The variation in distribution of fire patches in the landscape and over time is also more random and varied than regulation of the landscape through harvest.

A management ignited prescribed fire program was initiated in the 1960s for wildlife browse production on south aspects in the lower part of the canyon. This program has begun to compensate for years of fire suppression. The program has been implemented more frequently than natural fire regimes in the North Selway Face ERU, and many other areas, especially on north aspects, have not been treated. See the discussion of disturbance frequency and size by watershed for further treatment of how natural disturbances resulted in variation in states across the landscape.

Table 4.31: Fire, Harvest and Prescribed Fire Disturbance by Decade

Decade	Wildfire acres (percent)	Harvest acres (percent)	Management ignited fire (percent)	Cumulative disturbance (percent per decade)
1870s	10,764 (0.8)	unknown	none	.8
1880s	198,066 (15.0)	unknown	none	15.0
1890s	38,286 (2.8)	unknown	none	2.8
1900s	38430 (1.1)	unknown	none	1.1
1910s	553,047 (40.8)	unknown	none	40.8
1920s	25,107 (1.9)	unknown	none	1.9
1930s	145,082	136 ac	none	10.7

Decade	Wildfire acres (percent)	Harvest acres (percent)	Management ignited fire (percent)	Cumulative disturbance (percent per decade)
	(10.7)	(<0.1)		
1940s	5092 (0.4)	unknown	none	.4
1950s	0 ac (0.0)	484 ac (<0.1)	none	0.0
1960s	5452 (0.4)	7448 ac (0.5)	unknown	.9
1970s	30896 (2.3)	9989 ac (0.7)	41 (<0.1)	3.0
1980s	82905 (6.1)	7132 ac (0.5)	13,405 (1.0)	3.0
1990s	64,624 (4.5)	7551 ac (0.6)	2066 (0.2)	4.7

Disturbance Regime Alteration

One of the principle goals of ecosystem management is to maintain evolutionary and ecological processes (Quigley et al., 1996). Hydrologic cycles, carbon cycles, and plant succession are essential ecological processes. Disturbance regimes describe the frequency, severity and scale of events, including fire, erosion, and peak stream flows that provide settings for plant and animal communities. Significant alteration of disturbance regimes can affect the persistence of plant and animal communities, and exceed the rate of change to which species can adapt.

Fire has been a principal agent of change in landscapes in the subbasins. Fire regimes describe the frequency, severity, scale and pattern of fire in the landscape (Heinselman, 1981). Timber harvest and fire suppression have been more recent agents of change, and may not be sustaining ecological processes. To test this, we evaluated three forms of departure from historic fire regimes: frequency of disturbance, severity of disturbance, and size of disturbance, comparing historic fire to recent harvest.

Disturbance Frequency and Severity at Stand and Watershed Scales: Disturbance frequency was evaluated at two scales: the stand and the watershed. To evaluate changes in disturbance frequency at the stand scale, we used harvest history, wildfire history and prescribed fire history, as well as historic fire regime. If a stand had been harvested or was within a fire perimeter, and the fire or harvest had occurred within the maximum period for the fire regime of that stand, the stand was considered within the historic range for disturbance frequency. Stands outside that range are shown in Map 35.

Departures from stand level disturbance frequency are dominantly in the low elevation and canyon sites where historically frequent fire had been typical. These departures are especially marked in the Upper Selway Canyon, Running and Goat, Indian Creek, Deep Creek and Little Clearwater ERUs. Fires in year 2000 addresses some of this departure in Upper Selway Canyon and Little Clearwater ERUs. Management ignited prescribed fires have compensated for some of the effects of past fire suppression on low elevation south aspects in the North Selway Face ERU. About 1,000 acres have been burned annually since 1985. These are usually spring burns and do not necessarily replicate the effects of historic fires, but do reduce fuel accumulations.

The disturbance frequency at the watershed scale was evaluated by computing the frequency of harvest and fire, normalized to a 100-year scale. Only disturbances of more than 10 acres were considered. Results are shown in Table 4.32. Watersheds are stratified by their dominant

expected fire regime. Departures in disturbance frequency at the watershed scale include:

- From 1935 to 1978, during the period of fire suppression, wildfire frequency was substantially below the range from 1870 to 1934 in all areas.
- From 1979 to 1996, fire frequency was still below presettlement ranges over the subbasins as a whole.
- Currently, many fires are still suppressed in wilderness before they become large, and all fires are suppressed outside of wilderness or other approved fire use areas.

Harvest frequency in the lower part of the Selway subbasin and the Middle Fork Clearwater subbasin has been more frequent than historic fire disturbance in two settings: the watersheds dominated by high elevation lands subject to infrequent severe fire (upper Meadow Creek), and the low elevation, moist canyons and uplands subject to infrequent mixed severity fire (most of the Lower Selway, Clear Creek, and Middle Fork ERUs).

In the low elevation watersheds subject to frequent low severity fire, harvest frequency has been comparable to presettlement fire frequency. The 44-year period of fire suppression and little harvest means that many disturbances that we would now expect to be about 20 to 60 years old, never occurred, so that sapling and pole size communities are in relatively short supply compared to historic, while medium tree stands are more abundant than we would expect in a natural landscape.

Management ignited fire has been more frequent in all settings than presettlement fire frequency. This, combined with smaller disturbance size, means that management ignited fires tend to be more frequent, but smaller, than historically. This is exemplified by the repeated burning of North Selway Face ERU winter range.

The combined effects of harvest, wildfire, and prescribed burning suggest that disturbance processes in roaded portions of the subbasins are at a higher frequency, smaller scale, and lower variability in size and severity than historically. Wilderness areas still do not experience natural variability in frequency and size compared to presettlement process.

Table 4.32: Median Disturbance Frequency/100 Years by Watershed

	Watersheds with mixed high and low elevation, frequent and infrequent fire regimes	High elevation watersheds with infrequent, severe fire regimes	Low elevation watersheds with frequent, low and mixed severity fire regimes	Low elevation watersheds with infrequent, mixed severity fire regimes
1870-1934 Pre Fire Suppression	Fire: 4.6 Harvest: 0	Fire: 3.1 Harvest: 0	Fire: 3.1 Harvest: 0	Fire: 3.1 Harvest: .05
1935-1978 Fire	Fire: 0.0	Fire: 0.0	Fire: 0.0 Harvest: 2.8	Fire: 0 Harvest: 4.5

	Watersheds with mixed high and low elevation, frequent and infrequent fire regimes	High elevation watersheds with infrequent, severe fire regimes	Low elevation watersheds with frequent, low and mixed severity fire regimes	Low elevation watersheds with infrequent, mixed severity fire regimes
Suppression	Harvest: 0	Harvest: 9.1		

RARE AND IMPORTANT PLANTS AND PLANT COMMUNITIES

Arcross the Middle Fork and Selway subbasin, there are unique areas, special features and localized environmental conditions that provide habitat for many rare and uncommon plants. Because of its maritime climate, the low elevation canyons of the Middle Fork and Lower Selway support species adapted to temperate, more humid zones of the Pacific Northwest. This suite of species is referred to as coastal disjuncts because they are isolated from the coastal populations. They are thought to be relicts of Miocene vegetation that survived regional climatic changes in these protected canyons (Lichthardt and Moseley 1994). The Clearwater basin also contains plant species near the southern limits of their range or disjunct from the boreal regions to the north, and a few plants found only within the western drainages of the Northern Rocky Mountain region. The mixing of boreal, maritime and rocky mountain flora in the Clearwater Basin and Selway Subbasin creates unique floristic areas that contribute greatly to the local plant diversity.

The sites for these important plants are microhabitats of the VRUs discussed in Chapter 5.

Coastal Disjunct Plant Communities

Perhaps the floristic zone that best represents the uniqueness of the analysis area is the low elevation canyon of the Middle Fork and Selway rivers. Due to the high number of coastal disjunct species along with a number of endemic species, the habitats found within these low elevation moist canyons can be considered as rare or sensitive. Core areas of the Clearwater Canyon refugium are closely tied to the distribution of the western red cedar/maidenhair fern habitat type and inclusions of wetter fern understory unions.

The following are relatively rare species associated with the canyon refugia, in these subbasins:

Blechnum spicant (deerfern) - coastal disjunct
Botrychium spp. (moonworts) - generally rare
Cardamine constancei (Constance's bittercress) - Idaho endemic
Carex hendersonii (Henderson's sedge) - coastal disjunct
Cornus nuttallii (Pacific dogwood) - coastal disjunct
Mimulus clivicola (bank monkeyflower) regional endemic
Corydalis caseana var. hastata (Case's corydalis) - Idaho endemic
Cypripedium fasciculatum (Cluster lady's slipper) - generally rare
Equisetum telmateia (Giant horsetail) - coastal disjunct
Festuca subuliflora (crinkle-awn fescue) - coastal disjunct
Eburophyton austinae (Phantom orchid) - coastal disjunct
Selaginella douglasii (Douglas's spike-moss) - disjunct

The best expression of the Clearwater refugium in the planning area occurs along the north facing slopes from the forest boundary to Meadow Creek below 3,000 ft elevation (VRU's??). This area supports the highest concentration of Constance's bittercress within the Clearwater and St Joe River Basins (Lichthardt and Moseley, 1994). Henderson's sedge, Cluster lady slipper,

Phantom orchid, Case's corydalis can also be found scattered in many of the smaller drainages. Potential coastal disjunct habitat in the planning area was modeled using elevation, aspect, and geographic boundaries, and known plant locations, and is shown on Map 48.

A similar pattern can be seen in the bryophyte flora. A number of bryophytes with maritime affinities are commonly found in the Selway and Middle Fork river canyons. Generally bryophytes have a wider distribution than vascular plants and tend to develop similar flora under widely dispersed climatic regions (Schofield 1985). Within the Clearwater refugium area a combination of relatively high humidity, mild winters, indirect illumination and diverse substrate provide conditions that are relatively rare in the Rocky Mountains. Therefore, the bryophyte assemblages associated with these river canyons are relatively rare in the intermountain west. The following are a few uncommon bryophyte associated with Western Red Cedar habitat along the Selway river canyon.

Scapania bolanderi
Tripterocladium leucocladulum
Buxbaumia viridis
Orthotrichum striatum
Porella platyphylloidea
Rhytidiadelphus loreus
Thamnobryum neckeroides
Hookeria lucens
Rhizomnium nudum
Claopodium crispifolium
Neckera douglasii
Anitrichia curtipendula
Isothecium stoloniferum

Status and Threats to Coastal Disjunct Species: The most widespread threat to coastal disjunct populations is due to their occurrence within the river corridor, in the path of residential and recreational development, recreational activities, and invasion by non-native plants.

Table 4.33 shows the distribution of potential coastal disjunct habitat and that remaining after campground, road, trail, and residential development, and probably loss to private ownership. The Middle Fork and Clear Creek have probably lost important proportions of their habitat and populations.

Table 4.33: Potential and Existing Coastal Disjunct Habitat and Percent Remaining after Impacts of Human Activities

ERU	Potential Habitat (acres)	Existing Habitat (acres)	Percent Remaining
Middle Fork Clearwater	17,066	9657	57
Clear Creek	4441	579	13
North Selway Face	686	681	99
Lower Selway Canyon	7801	7445	95
Middle Selway Canyon	5849	5717	98
Otter-Mink	971	971	100
Lower Meadow Creek	5341	5279	99
O'Hara Goddard	7612	7370	97
Gedney Three Links	554	545	98

Pacific Dogwood: Pacific dogwood occupies forest edge and gap openings, and may require some level of disturbance to maintain or create adequate light conditions. Pacific dogwood is also in a severe decline due, at least in part, to a fungal disease known as dogwood anthracnose (Hibben 1992). Population numbers may have decreased 75-90 percent over the past 10-15 years (Lichthardt 1991). Seed have been collected and are being stored as an emergency conservation measure.

Constance's Bittercress: Constance's bittercress appears to have some dependence on periodic low or moderate severity fire to induce flowering and seed set, and to reduce overstory shading. It also appears capable of persistence for long periods by vegetative reproduction, under fairly closed canopy conditions. Because Cardamine populations are small and isolated from one another, they may be subject to local extinction from severe harvest, fire, or other ground disturbance. Clear-cut harvest or severe burns may provide too intense light and drought conditions (Crawford 1980, Lichthardt and Moseley 1994).

Henderson Sedge: Henderson sedge may be associated with elk travel routes, so ungulates may be a spread vector. The species occurs in canopy gaps in old growth forest, to shaded understory positions. Source areas may be linked to moist microhabitats with mild winters. Its response to disturbance is not known.

Deerfern: Deerfern occurs at the cold, moist edge of coastal disjunct habitat, and is associated with varied overstory structure, but generally under moderate to high canopy cover. Effects of disturbance are little known, but the small and isolated populations, and occurrence in forest types little visited by fire, suggest that disturbance due to fire or harvest may pose a risk to the species' persistence.

Bank Monkeyflower: Bank monkeyflower occurs over a wider range of sites than coastal disjunct species proper, and occupies microsites of open pockets of exposed mineral soil within forest openings in the local Douglas-fir zone, but within the range of cedar. It is an annual that requires spring moisture and exposed soils for germination. It has been associated with small depressions created by ungulate hooves. Invasion by non-native plants could threaten its

persistence in these openings, which are susceptible to weed expansion. Little is known about the persistence of seed viability and germination characteristics.

Mature Lodgepole Pine Communities

Most of the Wilderness ERUs as well as Meadow Creek support lodgepole pine communities that comprise 15-25 percent of the ERU. These plant communities are found on well-drained coarse textured soils of low productivity at upper elevations of the montane zone. The sites receive heavy snows in the winter and rain in the spring, but turn droughty in the summer and fall. The lodgepole stands are seral to subalpine fir and grand fir. The understory is open with grouse whortleberry and scattered beargrass. Plant diversity is relatively low. However, mature lodgepole communities that develop a sparse but sheltered understory provide suitable habitat for candystick (*Allotropa virgata*) a rare plant in the northern Rocky Mountains and a Regional Sensitive Species (Lichthardt and Mancuso 1991, Lichthardt 1992) *Need citation*. It also provides substrate to a rare granite moss, *Andreaea heimemanii*.

Candystick is a non-chlorophyllous plant that forms a three-way relationship (tripartite symbiosis) with lodgepole pine, occasionally with grand fir or subalpine fir, and mycorrhizal fungi. Large woody debris from decaying logs and buried decomposed wood are important in maintaining moisture on the well drained sites for both the fungi and candystick. The species forms a complex relationship with fungi and lodgepole pine. It is not known if this species can switch hosts as lodgepole is replaced by subalpine fir, or how long it takes this species to recolonize disturbed sites.

Andreaea heimemanii is rare in Idaho. It is found on medium to coarse grain granite boulders at the soil surface within the upper montane zone sheltered by lodgepole pine. The rock substrate tends to be gentle sloping to flat with micro-depressions and fissures. The position, texture and micro-relief of the rock seem to capture and hold moisture longer than fine-grained granite or boulders with sloping faces.

Status and Threats to Lodgepole Pine Communities - Periodic fire that regenerated lodgepole pine communities would seem to threaten local populations of candystick as would severe logging that removes the host trees and the sheltering canopy. Monitoring has documented declines in candystick populations as the lodgepole canopy is removed. However, without periodic fire, the lodgepole pine would not persist in the landscape. It is likely that Candystick slowly recolonized burned sites from unburned or lightly burned refugia that contained the critical structural components needed by the plant to persist after large fires. Maintaining presettlement frequency and scale of fire disturbance in lodgepole pine communities may provide the basis for the long-term persistence of candystick at the landscape scale.

Sub-Alpine Plant Communities

High elevation plant communities include parklands of sub-alpine fir and whitebark pine communities, non-forested sub-alpine balds and ridge tops and upper montane herblands dominated by grasses, sedges and forbs. These communities occur in all Wilderness ERUs except for the low elevation canyon ERUs. The comprise 1-10 percent of each ERU. Some montane park is recently burned herblands, and some is more persistent. Many areas, now considered herbland, may once have supported open stands of whitebark pine. These herblands may provide habitat for rare plant communities, as well as provide forage for domestic and wild animals, including small mammals.

This zone contains a variety of high elevation plant species that are relatively rare or are of concern in the Selway and Middle Fork Drainages:

Idaho douglasia (*Douglasia idahoensis*) - Idaho Endemic
Whitebark Pine (*Pinus albicaulis*) - Western Endemic
Tweedy's ivesia (*Ivesia tweedyi*) - Disjunct

California sedge (*Carex californica*) - Coastal disjunct
 Dasynotus (*Dasynotus daubenmirei*) - Idaho Endemic

Idaho douglasia— This forb species grows in high elevation subalpine habitats in VRU 9. It is a Idaho endemic of the central mountains of Idaho. Idaho douglasia prefers open subalpine ridges, summits and adjacent slopes on north to northeast aspects with gravelly soils and scree of recently decomposed granite. Vegetation is typically sparse, with widely spaced plants.

Whitebark Pine - Whitebark pine is a tree that occurs in high elevation environments. Whitebark persists as a climax species near timberline and is scattered in closed canopy forests of subalpine fir, Engelmann spruce, and lodgepole pine (Murdock 1991). In whitebark pine forests, fires occurring every 30 to 300 years have been important for the survival and regeneration of this species and is a key process affecting whitebark pine forest structure and composition (Morgan et al. 1994) *Need citation*. Both low intensity and stand replacing fires provide openings for regeneration and areas for wildlife species to cache seeds. Many wildlife species depend on whitebark pine as a valuable food source (Clark's nutcracker, red squirrel, and grizzly bears), as well as areas to roost and nest.

Status and Threats of sub-Alpine Communities: Ridgeline roads, trails, recreation sites and livestock trampling have negatively impacted a low percentage of the high elevation communities. Generally, the long term trends for these plant communities appears stable and to have changed little from historic levels. Localized impacts to specific population could occur from future trail construction, recreation use and livestock (horses) trampling. A notable exception is whitebark pine.

Over the past few decades whitebark pine has declined in abundance over most of its range (Murdock 1991, Morgan et al. 1994). In the absence of major disturbances, whitebark pine is becoming replaced by more shade tolerant species of subalpine fir and Engelmann spruce. White pine blister rust and the mountain pine beetle have been attributed to whitebark pine declines, by reducing cone production and killing mature trees (Morgan et al. 1994). The decline in whitebark pine abundance also threatens the availability of seeds that many species rely on as a food source. All the Wilderness ERUs with the exception of the low elevation canyon ERUs have experienced these declines. Restoration of fire and concurrent identification and protection of rust resistant seed sources are major priorities in suitable ERUs. More direct manipulation using prescribed fire and slashing may be possible in the O'Hara-Goddard and Running-Goat ERUs in nonwilderness areas.

The extent of the herbland communities has increased significantly (Appendix L), probably due to both conversion from whitebark pine communities and succession after fire. They are not hospitable sites for weed establishment, but are very sensitive to trampling damage, because of their very thin, gravelly soils and popularity for hiking. Monitoring some representative sites subject to such damage, to assess plant community change, is recommended.

Grand-fir Mosaic

Grand-fir mosaic is locally common in the subbasin but rare outside the Clearwater basin. Typically the zone is a mixture of grand fir interspersed with sitka alder glades and tall forb communities of bracken fern and western coneflower. Pacific yew can be common as a secondary canopy under the grand-fir. Patches of old growth with natural openings of tall shrubs and forbs are important characteristics of the grand-fir mosaic. The mosaic has a combination of unique environmental and biological factors that appear to create and maintain the diverse patchiness and community structure (Ferguson 2000). Compared to the surrounding area the mosaic tends to have increased soil moisture, a shorter growing season, strongly acidic soils, allelopathic plants, and mixed severity infrequent fires. While conifer regeneration can be affected by these acidic soils, allelopathy, and pocket gophers (Ferguson 2000), old growth

conditions can develop as a result of the infrequent fires. The grand-fir mosaic also provides habitat for a number of endemic and disjunct plants such as the following.

Oregon bluebell (*Mertensia bella*) - Disjunct
Evergreen kittentail (*Synthesis platycarpa*) - Idaho endemic
Idaho barren strawberry (*Waldsteinia idahoensis*) - Idaho endemic
Payson's milkvetch (*Astragalus paysonii*) - Regional endemic

Pacific Yew Communities

Pacific yew is a slow-growing tall shrub or small tree that occurs as scattered individuals or small groves in low and mid elevation grand fir and cedar forests. It may occur on upland sites or in some riparian habitats, but not on poorly drained soils. Pacific yew is highly sensitive to fire and its presence is often an indicator of infrequent fire. Birds and rodents spread its seeds. Its bark and other parts contain taxol, a compound found to be effective in treatment of some forms of cancer. It is an important substrate in the Clearwater basin for epiphytic bryophytes. Plant communities with Pacific yew are a key winter range for moose. Pacific yew is most abundant in the Clear Creek, Middle Fork, and O'Hara-Goddard ERUs and lower Meadow Creek. Fire suppression has probably resulted in increased frequency and extent of Pacific yew, but timber harvest has been concentrated within the same areas. Pacific yew was typically slashed and burned during the course of harvest prior to 1987. From 1987 to 1991, timber harvest and burning were constrained in areas allocated to moose winter range. After the discovery of taxol, and development of the Conservation Guidelines for Pacific yew (USDA 1992), timber harvest and burning impacts to Pacific yew have been much reduced. Harvest for taxol ceased about 1994, but the Conservation Guidelines remain in effect.

Status and Threats to Pacific Yew Communities - Clear-cut harvest methods and broadcast burning for slash removal threaten Pacific yew. Forest fragmentation by harvest in the western portion of the subbasin has isolated Pacific yew stands, but spread by birds should help overcome this isolation. Some areas at increasing risk of large severe fires may pose a threat to loss of Pacific yew over large areas, in the event of such a fire. Introduction of lower severity fire to break up the continuity of fuels in the landscape could reduce this risk, and better sustain yew at the landscape level over the long-term.

Wetlands and Fen Communities

Wetland/fen complexes are limited in extent and rare in the subbasin. They are most prominent in upper Meadow Creek, Long Prairie Creek, and as small communities within shrub-forest-fen complexes along low gradient glacial valley bottoms and surrounding glacial lakes. Important remnants of boreal fens occur in the headwaters of West Fork O'Hara Creek. Wet sedges or Sphagnum and other mosses may dominate the Wetland and fens. These small wetlands may develop peat or organic soils as result of anaerobic conditions that make it possible for the rate of organic accumulation to exceed the rate of decay. Wet meadows and seeps along streams and Fens in the upper drainages provide habitat for a number of rare plants including the following.

moonworts (*Botrychium* spp.)
tall swamp onion (*Allium validum*)
sitka clubmoss (*Diphasiatrum sitchense*)
Mendocino sphagnum (*Sphagnum mendocinum*)
Helodium blandowii

Status and Threats to Wetlands and Fen Communities - There is little data available on the effects of fire suppression on these communities. There may have been some encroachment by conifers, but this is not documented. Fire suppression may also have affected hydrologic regimes, since most watersheds historically showed more evidence of fire disturbance, and consequently probably had higher water yields. All terrain vehicle use has impacted wet meadows in Upper Meadow Creek. Cattle may have affected wet meadows in Clear Creek, but

little data are available. Restoration of presettlement fire regimes in wilderness and suitable roadless areas would sustain these communities over the long-term. Monitoring of local impacts of grazing and all terrain vehicle use is recommended to adjust management to protect and restore these communities.

O'Hara Research Natural Area

The subbasin contains a research natural area (RNA) in the O'Hara Creek watershed (approximately 7000 acres). This RNA includes the East Fork of O'Hara Creek and parts of adjacent drainages. Its aquatic features are the primary focus of this RNA: a network of streams ranging from first to fifth order, and anadromous fish population, a series of cascades and waterfalls through narrow canyons, beaver-created ponds, and wet streamside meadows used by elk and moose. The plant communities include coastal disjunct species: *Syntheris platycarpa*, *Equisetum telmateia*, and *Lycopodium selago*. Elevations range from 2100 feet at the northern boundary to 6815 feet atop Iron Mountain. The current management of this area is to not allow any disturbance. However, fire has been a key process that occurred in this landscape, and maintained the diversity of plant communities. The management of the O'Hara Research Natural Area should be reevaluated to incorporate use of naturally ignited fire under some conditions, and possibly prescribed fire if needed to maintain landscape diversity.

Warm Springs Creek Research Natural Area

This RNA occurs in the Running Creek watershed. It comprises about 530 acres and includes two warm springs underlain by igneous rock of the Idaho batholith. This area is near the southern limits of western redcedar in Idaho. Pat fires have perpetuated a stands of old growth ponderosa pine. Elevations range from 3910 feet to 5320 feet at the northern end of the RNA.

NOXIOUS WEEDS AND EXOTIC PLANTS

Introduction

Exotic plant species is an important ecosystem attribute to consider when assessing watershed conditions and vegetation objectives. Invasive exotic plants have the potential to affect native species richness and frequency (Forcella and Harvey, 1990) erosion rates (Lacey et. al., 1989), ecological processes (Whisenant, 1990; Vitousek, 1986) and rare plants (Rosentreter, 1994). Bedunna (1992) noted that exotic plants may alter ecological equilibrium to a point where the change is permanent.

Significantly higher rates of sedimentation from runoff in knapweed-dominated sites has been documented in Montana (Lacey et. al., 1989). Cheatgrass and medusahead have altered fire frequencies in many areas of the Great Basin and intermountain region (Whisenant, 1990; Young, 1992). Purple loosestrife has significantly changed wetland vegetation structure in eastern North America, and the Pacific Northwest. Plant community structure along many canyon slopes in the Snake and Salmon River basins has shifted from a fibrous rooted bunchgrass community to one dominated by tap-rooted yellow starthistle, affecting habitat for chukar and other grassland birds.

Invasive exotic plants can expand following human-caused or natural disturbances and colonize degraded as well as intact habitats (Tausch et al., 1994; Watson et al., 1989; Willard et al., 1988; Belcher and Wilson, 1989). Forcella and Harvey (1983) documented Eurasian weeds dominating relatively undisturbed grasslands in Montana. Tyser and Key (1988) reported spotted knapweed invaded and reproduced in rough fescue communities in Glacier National Park.

Historical records indicate that many of these exotics were introduced from Eastern Europe into North America in the early 1900s, some as a contaminate in crop seed and animal feed and others as simply an ornamental flower. Without their natural predators and pathogens or with novel competitive mechanisms (Callaway and Aschehoug, 2000), these weeds have continued to expand and in some cases become the dominant species. Spotted knapweed has expanded in

Montana to over four million acres (Lacey et. al., 1995). Since 1977 yellow starthistle infestations in northern California have spread from one million acres to over ten million acres. This species also infests millions of acres in Oregon and Washington. In Idaho over 500,000 acres are infested, with the plant increasing at a rate of 6 to 60 percent per year (Callihan and Lass, 1996). Rush skeletonweed in Idaho has expanded from 40 acres in the early 1960s to over four million acres.

Present Situation

Weed colonization is an active process influencing many habitats in the Selway and Middle Fork Clearwater subbasins. Invasive exotic plants are a serious threat to the biodiversity and other resource values within the subbasins. In addition, new weeds first introduced in other parts of North America are now reaching the Northern Rocky Mountain area and the Clearwater basin. These new weeds present an additional threat to the habitats within the Selway subbasin.

Over the past few years agencies have been working on weed inventories across the Clearwater River basin. Based on herbarium records, University of Idaho Weed Diagnostic Lab records and agency reports, approximately 250 exotic plants have been found in the five-county area that makes up the Clearwater River basin. Fifty-three of these species are designated noxious by Idaho or adjacent states (Rice, 1997). Over 400,000 acres in the Clearwater River basin are infested with 40 invasive weeds according to the *Clearwater Basin Weed Management Area*, 1999).

Noxious weeds found in the Selway and Middle Fork Clearwater subbasins include:

- Spotted knapweed (*Centaurea maculosa*)
- Canada thistle (*Cirsium arvense*)
- Sulfur cinquefoil (*Potentilla recta*)
- Japanese knotweed (*Polygonum cuspidatum*)
- Everlasting peavine (*Lathyrus latifolius*)
- Scotch broom (*Cytisus scoparius*)
- Cheatgrass (*Bromus tectorum*)
- Common burdock (*Arctium minus*)
- Yellow starthistle (*Centaurea solstitialis*)
- Houndstongue (*Cynoglossum officinale*)
- Other common weeds

The weeds currently found in the subbasins have spread throughout the transportation system and occupy many habitats. Since the land is made up of both roaded and wilderness areas, this transportation network consists of roads and many miles of trails that extend from the valley bottom along the Middle Fork Clearwater and Selway Rivers to the high elevation peaks of the Bitterroot Mountains. Many of the existing weeds as well as new exotics have the potential to colonize many additional acres and spread to susceptible habitats.

Field surveys conducted over the past few years have documented many of the existing and potential problem weeds that occur in the subbasins. Individual infestations range in size from several square feet to hundreds of acres. Although the entire watershed has not been thoroughly surveyed, suitable locations such as roads, trails, dispersed and developed recreation areas, and outfitter and guide camps have been surveyed to indicate an upward trend in exotic species spread. It appears from field observations that the established weeds in the subbasins continue to spread from these highly used and disturbed areas into previously uninfested sites.

The majority of the identified infestations occur near roads, trails, and campsites, as well as in disturbed grasslands and open pine stands. Spotted knapweed is the most abundant weed and

occupies thousands of acres within the Selway River corridor from the headwaters in the Frank Church River of No Return Wilderness to the private lands at Lowell. Yellow starthistle is present along lower Clear Creek and is moving east from Kooskia in the transportation corridors. It has not been found along the Selway River; however, a small starthistle infestation has recently been found at Lowell. Canada thistle is common in the mid-elevation (2,500 to 5,500 feet) timber harvest units on the Nez Perce National Forest as an early pioneer weed in heavily disturbed soils.

Habitats Susceptible to Weed Colonization

All plant communities are subject to invasion or colonization, but they vary in their susceptibility to exotic plants. Both native and exotic plants establish themselves where resources are available. Plants may disperse and occupy areas within existing plant communities where light, space, water, and nutrient requirements can be met. Exotic plants can be expected to colonize those sites or habitats that provide the necessary requirements to complete their life cycle. Those habitats that lack the necessary resources for specific weeds are not considered susceptible to colonization. Habitat type groups (HTGs) found within the Selway and Middle Fork Clearwater subbasin assessment area have been rated for their susceptibility to exotic plants and noxious weed guilds found in the Clearwater River basin. The following ratings were used to classify habitat susceptibility:

- *Closed*: Habitat is effectively closed to weed colonization due to elevation, climate, substrate or existing plant community structure.
- *Low*: Habitat is slightly susceptible to weed invasion. Existing community structure and/or site characteristics limit weeds from exhibiting invasive behavior. Species may colonize highly disturbed sites but acts as ruderal species in the plant community.
- *Moderate*: Habitat is moderately susceptible to weed invasion. Sites provide characteristics where species can invade the herbaceous layer and become a common element across the plant community in the absence of intense and frequent disturbance.
- *High*: Habitat is highly susceptible to weed invasion. Site characteristics and plant community structure is such that species can colonize and dominate the herbaceous layer even in the absence of intense and frequent disturbance.

Weed Guilds

Weed guilds are groups of exotic plants or noxious weeds that share common growing requirements and generally colonize and affect similar habitats. Many weeds are capable of growing across a greater range of environmental conditions than those of their guild; however, weeds have been placed in the guild for which they have the greatest potential to impact the existing plant community.

Steppe and Savanna Weeds: This group of exotic plants has the greatest impact on hot and dry steppe grasslands and open dry ponderosa pine savannas. Habitats tend to be southerly aspects, relatively open vegetation structure with rocky shallow soils. Weed species include yellow starthistle, scotch thistle, dyers woad, rush skeletonweed, dalmatian toadflax, cheatgrass, common crupina, diffuse knapweed, and medusahead rye.

Montane Weeds: This group of exotic plants is capable of colonizing and becoming a member of warm and moist plant communities. Weed species include leafy spurge, sulphur cinquefoil, spotted knapweed, orange hawkweed, and Canada thistle. HTG 2, HTG 3, and drier portions of meadows (HTG 60) are often susceptible to these species.

Wetland and Meadow Weeds: This group of exotic plants is capable of affecting meadows, riparian areas and wetlands. Weed species include meadow hawkweed, common tansy, hoary

cress, purple loosestrife, and matgrass. Not all wet meadows are delineated at the scale of this assessment.

Table 4.34 shows the habitat type groups that are vulnerable to the three noxious weed guilds and Table 4.35 shows the habitat type groups vulnerable to various noxious weeds.

Table 4.34: Habitat Type Groups Vulnerable to Three Noxious Weed Guilds

Noxious Weed/ Exotic Plant Guilds	HTG 15 Bunch grass	HTG 30 Dry Shrub	HTG 60 Bottom- lands	HTG 1 Dry P. Pine	HTG 2 Doug-Fir	HTG 3 Dry Grand Fir	HTG 4 W/M GF	HTG 7/8/9 Sub- alpine Fir	HTG 10/11
Steppe/Savanna	High	High	Low	High	Moderate	Low	Low	Closed	Closed
Montane	Moderate	High	Moderate	High	High	Moderate	Low	Closed	Closed
Wetland/Meadow	Closed	Low	High	Closed	Low	Low	Closed	Closed	Closed

Table 4.35: Habitat Type Groups Vulnerable to Various Noxious Weeds

Susceptible Habitat	HTG 1 Dry conifer	HTG 15 Grassland	HTG 30 Shrub	HTG 60 Meadows	HTG 2 (with disturbance)
Acres susceptible to weeds (entire subbasin)	4,322	3,058	Unknown, none mapped	655	204,065
Acres susceptible to weeds (NFS lands)	<200	<500	Unknown, none mapped	655	184,094

Map 46 shows areas most susceptible to weed invasion in the subbasin, based on habitat type group. Habitat type groups 1 (warm/dry ponderosa pine), 15 (bluebunch wheatgrass and Idaho fescue), 30 (dryland shrub habitat types), and 60 (meadows) are inherently susceptible habitats that specific weeds can colonize and dominate without human-caused or natural disturbances. The weeds are capable of invading intact native plant communities and out-competing native plants for nutrients, water and growing space. HTG 2 (Douglas-fir, ponderosa pine or dry grand fir habitat types with shrub understories) is vulnerable to weed colonization if soil is disturbed. The disturbance could be human-caused or natural.

Noxious weeds can also be found along the edges and openings of habitats that are not inherently susceptible to weed invasion, like roadsides and trails. Disturbances may allow short term expansion of weeds into areas. These weeds may not represent a risk to the existing plant community or pose a threat to ecosystem process and function, but can act as a seed and propagule reservoir for future dispersal into more suitable sites. Weeds establish from many small disjunct patches from independent populations (Moody and Mack, 1988). With time and available suitable habitat, these patches may expand and coalesce into an apparently single infestation. Small infestations that do not pose a current threat to the existing plant community may still contribute to the spread of the species by acting as a founder population for new disjunct patches.